Title of the Invention :

POWER SUPPLYING APPARATUS FOR VEHICLE AND INTENSIVE WIRING APPARATUS

Background of the Invention:

This application claims the priority of Japanese patent document 10 188549, filed July 3, 1998, the disclosure of which is expressly incorporated by reference herein.

The present invention relates to [a power] an apparatus for supplying [apparatus for supplying a] power from a power supply [which is mounted on a vehicle of] to plural electric loads mounted on [the] a vehicle, and [in] particularly [relates to a power supplying apparatus suitable for use in] an automobile.

In a vehicle, an electrical [mounting component] supply system is installed [as] for the various kinds of the electric loads. [And, for example, in] In an automobile, for example, various power supply wire harnesses are used to supply power from a power supply [supplying apparatus] such as a battery and a generator[, to supply a power] to the various [kinds of the] electric loads[, various numbers of power supply wire harnesses are used].

[And, when] When an electric power line (a wire harness) is [carried out] used for [a] wiring [to] an actual vehicle, taking into consideration [about a wiring working performance and a mending working of a fail time, a manner in which] the labor involved in wiring and repairs, each area of the vehicle (such as an engine compartment [room], an interior portion of [a] the cabin, a trunk [room], or a door) is [each, by dividing the wire harness, they are] connected by separating the wire harness, and using a connector. Accordingly, power is supplied to [these] the several harnesses [which are divided plural numbers using the connector, the power is supplied] through the various kinds of the connectors to reach the end loads from the power supply [supplying apparatus] (such as the battery).

Further, in the above described power [supplying] supply system, [in the vehicle stated in above, in] generally one side [ground] of the power supply system is used [, in other words, as one side of the power supply line from the power supply, a power supplying system in which] to supply a part of a vehicle body. [of the vehicle is utilized is adopted, for] For this reason, [a short occurrence (] a short circuit [abnormality) is generated] occurs only by touching the electric power line to the vehicle body.

Therefore, in the conventional vehicle power [supplying] supply apparatus [for the vehicle], since a fuse box is provided

[to] at a predetermined [place of] location in the vehicle, and further a fuse (a fusible chip[)] for protecting against an over-current) is provided at [every] a predetermined load system, [each from the power supplying apparatus,] when [the] a short [is occurred] occurs in the electric power line, [by fusing the fuse] the power supply is [separated] isolated by the fuse, so that [and accordingly the protection of] the apparatus [can be obtained] is protected. [And, such] Such a fuse is [received in a lump] housed in a lower portion of a console box of the automobile, and in a fuse box which is provided to an interior portion of the trunk [room].

Accordingly, in the prior art, [in accordance with] depending on its nature, [the load,] the load [is] may be connected to the power supply [with] by a very long wire harness. Further, when the electric power line is [performed the short-circuit] short-circuited and [becomes a fail, to before of the fusing of the fuse, and not to generate the smokes] fails in order to avoid generating smoke in the electric power line before the fuse flows, it is necessary for the circuit to be able to accommodate an increase of the normal [make a regular] current of the electric power line up to [a] fuse [regular] current of the fuse[, as]. As a result, the vehicle uses a [bold] heavy gauge wire [line is used] as the electric power line.

Further, [even] if the [fitting-into portion] coupling of the connector is [loosed] loosened at a midway point of the wire harness and [then the fail on the connection of] the connector [occurs] fails, the power supply to the load becomes unstable. [Further, since] Since the wire harness is [carried out the wiring by hiding] normally hidden in an inner [side of a] trim (an interior mounting), [there are problems in which a specification of] the identification of the shorted [short abnormality] portions of the electric power line and [a specification of a place in which the fail on the] the location of a failure in connection of the connector, are difficult.

[As to] To solve the above [the above stated solving] problems, the [inventors of the present invention] applicants have proposed a new power supply [supplying] system in an international [announcement] laid-open publication No. WO 96/26570.

Summary of the Invention :

[The present invention is devised further the above stated new system and has following objects.]

An object of the present invention is to provide a power [supplying] supply apparatus [wherein a high reliability performance can be obtained against to an abnormality] which is

highly reliable with respect to abnormalities (such as, for example, a short-circuit) of an electric power line.

[Further, another of] Another object of the present invention is to provide a power [supplying] supply apparatus [wherein the] in which power can be supplied using a wire harness having a [comparative] comparatively low regular current.

[Further, a] A further object of the [present] invention is to provide a power [supplying] supply apparatus for a vehicle in which [wherein] an [abnormality portion] abnormal and/or [a fail] failed portion of [the] a connection [of a connector], due to [during a generation of] a short-circuit [abnormality] of [a] the wire harness, can be easily located.

[Further, a further more] Still another object of the [present] invention is to provide a power [supplying] supply apparatus [wherein an unnecessary] which prevents unnecessarily high load current [is not flown] to an electric power line, and [a] reduces consumption of electric power [can be reduced].

[A further more] Yet another object of the [present] invention is to provide a power [supplying] supply apparatus [wherein] in which a fuse and a relay are arranged [at a] in the vicinity of a control module, and [a] power supply wiring can be shortened.

One object stated [in] above is attained [that] by providing a fuse and/or an electric line shutdown apparatus (for example, a relay, a self shutdown switching element, such as a circuit breaker) between [a] the power supply and [an] the electric load. [a fuse and/or an electric line shutdown apparatus (for example, a relay, a self shutdown switching element) is arranged, and to the short, a] In this manner, double protection [system] or even a triple protection [system] is provided against a short circuit.

Another object can be attained [that through] by means of a control unit from [a] the power supply[, to]. To supply [a] power to an electric load [one side ground] in a vehicle having a supply system in which [a] one side is grounded to the car body of a vehicle, [is] a conductive electric line is [carried out] provided, and to connect equivalently in parallel at a respective control [units] unit an impedance of a power line, the control unit is connected to an electric power line .for a load.

[Further object can be attained that] According to another feature of the invention a power supply [supplying] line for [a] the control unit is arranged independently [to a] of the power supply [supplying] line for [a] the load, and [at] an improper shutdown of the [unnecessary time a] power supply for the load is [performed the shutdown and] controlled through a shutdown circuit.

[Further] <u>Another</u> object can be attained [that] <u>by providing</u> an independent short sensor [is provided] at plural intervals of an electric power line[, and when]<u>. When</u> a short [abnormality and] <u>circuit or</u> a [fail] <u>failure</u> of <u>the</u> connection [of a] <u>at the</u> connector [abnormality is generated, it is judged that the abnormality is detected at which interval] <u>occurs, the interval at which the failure has occurred can be determined</u>.

Further, it is preferable to combine the present invention with a system in which a control signal is received and sent between plural control units in accordance with a communication control.

Further, in the present invention, a control module has a relay and/or a fuse between [an] <u>the</u> electric power line [for a load] and [an] <u>the</u> electric load[, the]<u>. The</u> relay and/or the fuse is [received at a] <u>situated in the</u> vicinity of the control module which controls the electric load. Preferably, a relay box and/or a fuse box is [installed to] <u>integrated into</u> the control module <u>in a single</u> [as one] body<u>, constituting a</u> [and then the] control unit [is constituted].

<u>Other objects, advantages and novel features of the present invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawings.</u>

Brief Description of Drawings :

Fig. 1 [is a system] shows the arrangement of an automobile [to] in which the present invention is [applied] implemented;

Fig. 2 [is] shows a first embodiment of a whole system [view] of an automobile [to] in which the present invention is [applied] implemented;

Fig. 3 [is] shows a second embodiment of a whole system [view] of an automobile [to] in which the present invention is [applied] implemented;

Fig. 4 [is] shows a third embodiment of a whole system [view] of an automobile [to] in which the present invention is [applied] implemented;

Fig. 5 [is] shows the construction of the PIM module [construction view] of the system [shown] in Fig. 2;

Fig. 6 [is] shows the construction of the BCM module [construction view] of the system [shown] in Fig. 2;

Fig. 7 [is] shows the construction of the RIM module [construction view] of the system [shown] in Fig. 2, Fig. 3 and Fig. 4;

Fig. 8 [is] shows the construction of the PCM module [construction view] of the system [shown] in Fig. 2;

Fig. 9 [is] shows the construction of the DDM module [construction shown] of the system [shown] in Fig. 2, Fig. 3 and Fig. 4;

Fig. 10 [is] shows the construction of the FIM module [construction view] of the system [shown] in Fig. 3 and Fig. 4;

Fig. 11 [is] shows the construction of the BCM module [construction view] of the system [shown] in Fig. 3;

Fig. 12 [is] shows the construction of the PCM module [construction view] of the system [shown] in Fig. 3;

Fig. 13 [is] shows the construction of the BCM module [construction view] of the system [shown] in Fig. 4;

Fig. 14 [is] shows the construction of the PCM module [construction view] of the system [shown] in Fig. 4;

Fig. 15 [is] <u>shows the construction of</u> another embodiment of FIM module [construction view] of the system [shown] in Fig. 2;

Fig. 16 [is] <u>shows the construction of</u> another embodiment of BCM module [construction view] of the system [shown] in Fig. 2;

Fig. 17 [is] <u>shows the construction of</u> another embodiment of RIM module [construction view] of the system [shown] in Fig. 2;

Fig. 18 [is] <u>shows the construction of</u> a motor drive H bridge circuit [construction] (1);

Fig. 19 [is a] <u>shows the construction of another</u> motor drive H bridge circuit [construction] (2);

Fig. 20 [is a] <u>shows the construction of another</u> motor drive H bridge circuit construction (3);

Fig. 21 [is a] <u>shows the construction of another</u> motor drive H bridge circuit [construction] (4);

Fig. 22 [is] <u>shows the construction of</u> an over-current detection circuit [construction] according to a shut resistor;

Fig. 23 [is] shows the construction of an over-current detection circuit [construction] according to a shut resistor and a fuse;

Fig. 24 [is] shows the construction of an over-current detection circuit [construction] according to a PTC [PCT] element;

Fig. 25 [is] shows a characteristic of a PTC [PCT] element;

Fig. 26 [is] shows the construction of a short sensor [construction] (1);

Fig. 27 [is] shows the construction of a short sensor [construction] (2);

Fig. 28 [is] shows the construction of a short sensor [construction] (3);

Fig. 29 is an operation waveform of a short sensor detection circuit;

Fig. 30 [is] illustrates an algorithm of power bus over-current detection and protection operation;

Fig. 31 is a logical value table (1) [of] for a load power supply shutdown circuit, during a power bus [fail] failure;

Fig. 32 is [a] another logical value table (2) [of] for a load power supply shutdown circuit, during a power bus [fail] failure;

Fig. 33 is a BCM Process flow chart which shows operation during a power bus [fail] failure;

Fig. 34 is a FIM process flow chart which shows operation during a power bus [fail] failure;

Fig. 35 is a RIM process flow chart which shows operation during a power bus [fail] failure, in which the logical value table shown in Fig. 32 is realized;

Fig. 36 is a RIM process flow chart which shows operation during a power bus [fail] failure, in which the logical value table shown in Fig. 33 is realized;

Fig. 37 [is] shows an algorithm [of] for load and short detection and protection operation;

Fig. 38 is an algorithm [of] for load over-current detection and protection operation;

Fig. 39 is a lamp current characteristic;

Fig. 40 is a motor current characteristic;

Fig. 41 is a current characteristic during plural drive operations;

Fig. 42 is a module construction view (1);

Fig. 43 is [a] another module construction view (2);

Fig. 44 [is] shows the construction of a connector having a shut resistor [construction view] (1); and

Fig. 45 [is a] shows the construction of another connector having a shut resistor [construction view] (2).

Description of the Invention :

Fig. 1 shows a whole system view of an automobile in which the present invention is adopted, [and shows] including an arrangement of components [for constituting] to implement the present invention. [3 denotes a] A battery 3 supplies power to a whole vehicle [and] through a fusible link 4 which is arranged [closed by] close to the battery 3. [the battery 3 supplies a power Supply to a whole vehicle.] A power train control module

(PCM) 10 [carries out the] controls [of a] fuel injection amount, [and an] engine ignition timing, [of an engine and a control of a] throttle valve opening degree, and [a control] operation of an engine transmission.

The above Stated PCM 10 is installed [to a portion closed by] near the engine (for example, at an outer wall of [an] the intake air conduit, the [and an] outer wall of a [serge] surge tank [and] or an interior portion of [an] the air cleaner). [To PCM 10, various] Various sensors such as an air flow meter, a water temperature sensor and a crank angle sensor are connected to PCM 10, [and further] as well as an actuator group comprised of an injector 9, and an ignition means, a throttle motor 35 for opening and closing a throttle valve as the electric loads [are connected].

A control module 11 for an anti-lock brake system (ABS) [use] is mounted at a rear portion of [an] the engine [room] compartment which is provided [adjacently] adjacent to ABS use actuator. An air conditioner control unit (A/C) 16 is arranged [at a] in the vicinity of [a] the dashboard of a passenger seat, and [which] is positioned [at a] near [portion of an installation place of an] the A/C [use] temperature sensor and the actuator. An airbag control module (SDM) 25 is mounted [at a] in the vicinity of a center console box.

A body control module (BCM) 14 connects a display device [at a] in the vicinity of [a] the steering wheel near switches for [and] an ignition key [switch] 26, a hazard [switch] light 27, a [winker switch] flasher, a wiper [switch] etc., and is installed [to at a vicinity of] in or near the dashboard.

Each of these modules has at least an execution processing unit or a central processing unit (CPU) and a communication circuit (a communication IC) for carrying out [a] data communication [between] with other modules. Each of the modules is installed [at a vicinity of] near the devices (such as the sensor and the electric load, etc.) which are connected to [these modules and according to] it. In this manner, the [a] length of [a] the harness between the devices which are connected to these modules can be shortened.

A front integration module (FIM) 5 is arranged at [a] the front portion of the engine [room which is provided adjacently] compartment, adjacent to head lamps 1, 6. turn signal lamps 2a, 2b (left), and 7a, 7b (right), and is connected to drive the above stated head lamps 1, 6, the turn signal lamps 2a, 2b, 7a, 7b and a horn 8 which is mounted closed by.

A driver door module (DDM) 18[,] and a passenger door module (PDM) 20 are mounted [to a door at a] on the driver [seat side] and [a door at the] passenger [seat] side doors, respectively,

and are connected to [and] door lock motors 19, 21, a power window motor, a door lock switch (SW), a power window switch (SW), and an electric driven mirror motor (all not shown) [are connected].

A rear integration module (RIM) 29 [is] arranged at a front portion of the [engine room which is provided adjacently] trunk is connected to and positioned adjacent to tail lamps 32, 33 and turn signal lamps 31, 34, which it drives, together with [and is connected to drive the above stated tail lamps 32, 33 and the above stated turn signal lamps 31, 34 and further] a trunk opener [use] motor, a rear [defogging means] defogger, rear seat [use] door lock motors 23, 28, a power window motor, a door lock switch (SW) and a power window switch (SW), etc.[.]

Each of the above stated FIM 5, RIM 29, DDM 18 and PDM 20 has a communication circuit [which carries out a] for data transfer [between] with other modules[. Further, they have], as well as an input/output interface to which the [sensor] sensors and the [switch] switches etc. and the devices of the outside portion electric loads are connected, and an execution processing unit or a central processing unit (CPU) which executes a control signal to the electric loads. To [carry out the data] transfer data between these modules, a multiple communication line 30 (or data bus) is connected [connects] between the communication circuits of the respective modules.

As state above, since the respective modules [is] are arranged [at a vicinity of] near the devices to which [the modules] they are connected, and since [an] input data and [an] output data [of the] for devices to which [the device self is] they are not directly connected are received and sent between other modules through the multiple communication line, [a] data necessary for the respective modules can be obtained.

The multiple communication line 30 can be connected to a [diagnosis] diagnostic apparatus 13 through a connector 35 [and the diagnosis apparatus 13 can be obtained the] to obtain information from the respective modules, necessary for [the] diagnosis [from the respective modules through the communication line].

An electric power line from the battery 3 is connected to FIM 5 through the fusible link 4. [Between from] The FIM 5 is connected to BCM 14 [is connected] through an electric power line 12A, a connector 17A and an electric power line 12B[, between from]. BCM 14 in turn is connected to RIM 29 [is connected] through an electric power line 12C, a connector 17B and an electric power line 12D.[, between from] RIM 29 [to BCM 14] is connected to BCM 14 through an electric power line 12E, a connector 17C and an electric power line 12F[,]; and [between from] BCM 14 is connected to FIM 5 [is connected] through an

electric power line 12G, a connector 17D and an electric power line 12H, respectively.

Thus the electric power lines are wired [with] in a loop [shape] in the vehicle,[. As stated in above, the electric power lines are wired with the loop shape in the vehicle and to these loop shaped wired electric power lines] to which the respective modules are connected. In this manner, [and] the electric power lines are connected to the respective modules, and [then] the power is supplied to the various [kinds of the] actuators as [the] electric loads, through the respective modules.

The respective modules (in this embodiment, constituted by FIM, BCM, RIM) are [is constituted to be] arranged [every] one each to the engine [room] compartment, the passenger cabin and the trunk [room (in this embodiment, they are constituted by FIM, BCM, RIM)].

According to [the constitution of] this embodiment, the impedance of the power line [with] for each of the respective control units is connected in parallel (equivalently), [is connected in parallel equivalently and] so that a power system can be constituted using [the] electric power [line] lines having a small regular current. DDM 18, PDM 20 are arranged in the door, and are constituted to supply [the] power supply from BCM 14.

[A] The loop [shape wired] electric power line 12A-H is attached and detached by connectors 17A, 17B, 17C, 17D. The [and the] electric power [line] lines 12A and [the electric power line] 12H are arranged separately in the engine room, while the electric power [line] lines 12B, [the electric power line] 12C, [the electric power line] 12F and [the electric power line] 12G are arranged separately in [a room of] the vehicle passenger compartment; and [further] the electric power [line] lines 12D and [the electric power line] 12E are arranged separately in the trunk [room], respectively.

Accordingly, the electric power lines are [connected to wire with the] wired in a loop [shape] configuration. Alternatively, [and in addition to this] the control modules can also be connected with a star shape and a tree shape. For example, the electric power lines 12[H]E, 12F, 12G, 12H [are] connected by the connectors 17D [and 17C and when they are] can be detached from the apparatus [is] and constituted to form a tree connection [wiring].

Next, three embodiments [in which] with a loop [system] connected electrical [connection layout] power supply [supplying] system will be explained referring to Fig. 2, Fig. 3 and Fig. 4. Firstly, a construction of an embodiment shown in Fig. 2 will be explained.

The electric power line which is wired [with the] in a loop [shape explained] configuration in Fig. 1 is connected to a load power supply shutdown circuit 110 of FIM 5, from [form] the battery 3 through fusible links 4f and 4e. The power supply from the fusible link 4f is connected to the electric power line 12A via the load power supply shutdown circuit 110.

The electric power line 12A is connected via the connector 17A to one end of the electric power line 12B [according to the connector 17A and another] the other end of which is connected to a module [side] connector of [a latter stated] the BCM 14, and to a load power supply shutdown circuit 210 [of BCM 14] therein.

The electric power line 12B in turn is connected electrically to the electric power line 12C, [in which] one end of which is connected to a module [side] connector of [a latter stated] the BCM via the load power supply shutdown circuit 210.

Another end of the electric power line 12C is connected to one end of the electric power line 12D via [according to the] connector 17B and is connected to a load power supply shutdown circuit 310 of RIM 29 via [a latter stated] a module [side] connector of RIM.

[Another] The other end of the electric power line 12D is connected electrically to the electric power line 12E, [in which]

one end of which is connected to a module [side] connector of [a latter stated] the RIM via the load power supply shutdown circuit 310 [of RIM 29].

[Another] The other end of the electric power line 12E is connected to one end of the electric power line 12F [according to] via the connector 17C, while the other [and another] end of the electric power line 12F is connected to the load power supply shutdown circuit 210 of BCM 14, and to[. Another end of the electric power line 12F is connected electrically to] one end of the electric power line 12G via a module [side] connector of [a latter stated] the BCM. The other [and another] end of the electric power line 12G is connected to one end of the electric power line 12H [according to] via the connector 17D, while the other [and another] end of the electric power line 12G is connected to the load power supply shutdown circuit 110 of FIM 5 via a module [side] connector.

On the other side, the power supply from the fusible link 4e is connected electrically to [another] the end of the electric power line 12H through a [latter stated] module [side] connector via the load power supply shutdown circuit 110 of FIM 5, and as a result the electric power lines 12A - 12H are wired [with the] in a loop, [shape] through the fuses 4e and 4f. Hereinafter, [this] the loop [shape] wired electric power line is [given general name] referred to as a power bus 12.

[One example of the] The structure of [these] the electric power lines 12A, 12B, 12C, 12D, 12E, 12F, 12G and 12H, [as] is shown in Fig. 26, and is constituted [as] by a center [of an electric power line] 3020, an insulation member 3030 which [covers a surrounding portion of] surrounds the electric power line 3020, a conductive body 3010 which covers [an] the outer periphery of the insulation member 3030 and an insulation material 3000 which covers [an] the outer periphery of the insulation body 3010.

Herein, firstly the [electric power line] center conductor 3020 is made [by] of a single copper [single] wire or a copper twist wire and forms [an] a power supplying [use] conductive line. The insulation member 3030 is [made by] of an insulation [body] material such as a rubber and a plastic, and works to insulate the electric power line 3020.

The conductive body 3010 [is formed with] forms a layer [shape] at an outer periphery of the insulation member 3030 by knitting together (hereinafter, a "knit [assembly] wire") [the] thin copper [wire] wires. The insulation member 3000 is [formed by] made of an insulation [body] material such as a rubber and a plastic and functions as a protection layer [of a] for the cable. [A] (The function of the [above stated] conductive body 3010 will be explained in detail [in a latter portion and one] later.)

One end of the conductive body 3010 of the electric power line 12A is connected to a short detection circuit 230 of FIM 5 and [another] the other end presents an open state [at] in the vicinity closed by the connector 17A.

[Similar to] Similarly, one end of the conductive body 3010 of the electric power line 12B is connected to the short detection circuit 230 of BCM 14[,]; one end of the conductive body 3010 of the electric power line 12C is connected to a short detection circuit 230 of BCM 14[,]; one end of the conductive body 3010 of the electric power line 12D is connected to a short detection circuit 330 of RIM 29[,]; one end of the conductive body 3010 of the electric power line 12E is connected to the short detection circuit 330 of RIM 29[,]; one end of the conductive body 3010 of the electric power line 12F is connected to the short detection circuit 230 of BCM 14[,]; one end of the conductive body 3010 of the electric power line 12G is connected to the short detection circuit 230 of BCM 14[,]; and one end of the conductive body 3010 of the electric power line 12H is connected to the short detection circuit 130 of FIM 15, respectively.

Other ends of all of the electric power lines 12A, 12B, 12C, 12D, 12E, 12F, 12G and 12H present an open state [at] in the vicinity closed by the respective connectors. Hereinafter, this conductive body 3010 is called as a short sensor.

On the other hand, the [electric power line] center conductor 3020 starts from FIM 5 [stated in above] and is connected to return [with] through the conductive loop [shape] via the electric power line 12A, the connector 17A, the electric power line 12B, BCM 14, the electric power line 12C, the connector 17B, the electric power line 12D, RIM 29, the electric power line 12E, the connector 17C, the electric power line 12F, BCM 14, the electric power line 12G, the connector 17D, and the electric power line 12H.

The electric power lines 12A - 12H wired [with the] in a loop [shape stated in] as described above supply [the] power to the respective electric loads 190, 290 and 390 which are connected to the respective modules through the respective power supply shutdown circuits 110, 210 and 310 of the respective modules FIM 5, BCM 14 and RIM 29 and the respective load drive circuits (the driver circuits) 160, 260 and 360 of the respective modules FIM 5, BCM 14 and RIM 29.

Further, power is supplied to other modules DDM 18 and PDM 20, [the power is supplied] through the power supply [supplying] circuit 200 from the electric power lines 12B and 12G closed by the power supply among the electric power lines which are connected to the load power supply shutdown circuit 210 of BCM 14.

[To A/C 16, SDM 25 and a radio 15, a] A backup power supply is [supplied] provided to A/C 16, SDM 25 and a radio 15 from the power supply [supplying] circuit 200 of BCM 14 through the electric power line 50f. In addition to the load use electric power lines [stated in] referred to above, from the battery 3 to the control system [use] power [supply] is supplied to FIM 5, BCM 14 and RIM 29.

To the control system power supply circuit 120 of FIM 5, via the fuse 4c, [the] power [supply] is supplied to the control system use power supply circuit 320 of RIM 29 via the fuse 4d.

Accordingly, since the power supply [supplying] to the control systems is carried out by another system, even when one of the modules [becomes the fail] fails, the other modules can be operated.

The [above stated] power bus 12 supplies [the] power to the electric loads [which are called] (referred to collectively as a body electric component system or the equipment system) such as the control of [the kinds of] the head lamp, the stop lamp, the warning lamp, the power window, and the door lock.

Through another system, together with the above [stated] described body equipment system power supply [supplying] system, [the] power is supplied to the [injector] injectors for

controlling the fuel injection amount, to [and] the ignition apparatus for controlling the ignition timing, to an engine control module (ECM) for controlling the throttle valve opening degree, to an automatic transmission (ATM) for [carrying out] controlling the engine transmission, and a power train system power train control module (PCM), from the battery 3 via the fusible link 4a, the ignition switch 26a, the fuse 36b which are arranged in the vicinity of the dashboard, and the electric power line 50b.

[The power] Power is supplied to ABS control unit 11 via the fusible link 4a, [the] ignition switch 26a, [the] fuse 36a in the fuse box 36, and the electric power line 50a. [The] Similarly, power is supplied to the air bag control unit SDM 25 via the fusible link 4a, the ignition switch 26a, the fuse 36c in the fuse box 36, and the electric power line 50c.

[The] In addition, power is supplied to the radio 15 via the fusible link 4a, the accessory switch 26b, the fuse 36d in the fuse box 36, and the electric power line 50d[. The power is supplied to] , and to the A/C unit 16 from the battery 3 via the fusible link 4a, the accessory switch 26b, and the fuse 36e in the fuse box 36.

Accordingly, because every [the] control system [having the] has a separate function [each, the], a separate system power

supply system is formed[,]. Thus, even when one of the power supply systems [becomes the fail] fails, [any affect] no effect is [not given] imposed on to the other power supply systems.

[BCM 14 has the] The power supply [supplying] circuit 200 of BCM 14, [this power supply supplying circuit 200] is connected to the electric power lines 12B and 12G through the electric power lines 210b and 210g. Since the power is supplied to the radio 15, SDM 25, A/C 16 through the accessory switch 26b or the ignition switch 26a, when the accessory switch 26b or the ignition switch 26a [presents] are in an "off" state, [the] no power is [not] supplied.

[In] During this time, to back-up the data during the operation, even when the accessory switch 26b or the ignition switch 26a [presents] is in an "off" state, it is necessary to supply [the] power [supply].

Accordingly, [the] power for backing-up [the data of] these data is supplied from the power supply [supplying] circuit 200 of BCM 14 through the electric power line 50f. Since the data back-up use power supply [is] can be obtained by the power bus 12, it is unnecessary to provide [the another back-up use separate] an addition separate back-up use electric power line and [the] a fuse.

Further, these power bus systems 12A - 12H become to obstacle and the back-up data is eliminated, when the radio 15 and SDM 25, and A/C unit 16 are supplied [to the] with power through the accessory switch 26b and the ignition switch 26a, the operation is constituted to start with the initial value, the fatal trouble is not occurred.

The body electric component system module FIM 5, BCM 14, RIM 29, DDM 18 and PDM 20 [has] have respectively the communication circuits 140, 240, 340, 640 and 540, [and between the respective communication circuits is] which are connected by the multiple communication line 30.

Since the respective modules [receives] receive and [sends] send mutually the input and/or output information which relates to the whole vehicle (for example [such as] the condition of the ignition switch is inputted to BCM 14, according to the input signal which is taken into one module), the load which is provided to the [another] other separate module can be drive-controlled.

[To DDM 18 and PDM 20, the power] Power is supplied to DDM 18 and PDM 20, via [from] the power supply [sullying] circuit 200. For [these] generating responses, [the power supply circuit 500 and] the power supply circuit 620 [of the power supply circuit 520] of DDM 18 and the power supply circuit [620] 520 of

PDM 20 are [is] connected [to] respectively to the power supplying circuit 200 of BCM 14.

The load group 290 which is connected to BCM 14 [is received the] receives power through an output circuit (a driver circuit) 260. The output circuit 260 is connected to the power supply lines [units] 12c and 12f through the electric power lines 120c and 120f[. The output controls 260], and receives the control signal from a control signal output signal line group 270b of the control circuit 270. It [and] drives and [control] controls the load.

The control circuit 270 [output] outputs the load control signal to the output circuit 260 in accordance with [the] input [signal] signals which are inputted from the input circuit 250 and the input interface of the communication circuit 240, the ignition switch signal, the accessory switch signal and the receipt signal.

BCM module 14 has a short detection circuit 230 and monitors [a short abnormality of] the electric power lines 12B, 12C, 12F and 12G for short abnormalities. With the short detection circuit 230, for example, when a short [abnormally] of the electric power line 12F is detected, [such] a signal is inputted into the control circuit 270[, through an output signal line 270a the]. The load power supply shutdown circuit 210 is driven through an

output signal line 270a, and [an end] the portion of the power supply section 12F [having] in which the short [abnormality] occurs is contacted and separated.

[In] At this time, the control circuit 270 sends a signal which specifies the electric power line section having the short, [abnormality] to other modules through the communication circuit 240. A predetermined module RIM 29 which has received [the above stated] this signal controls a self load circuit 310 to separate the electric power line 12E which relates to the short abnormality through the self control circuit 370.

Accordingly, the electric power line section 12F having the short [abnormality] and the electric power line 12E which is connected to the section 12F through the connector 17C are separated from the loop [shape] configured electric power line[, after that]. Thereafter, power is supplied to the respective loads according to [the] a tree connection [line which are] comprised of the main line having the electric power lines 12A, 12B, 12C and 12D and the sub-lines 23, 24 and 50f which are wired from the power supply circuit 200 of BCM module 14[, the power is supplied to the respective loads].

FIM module 5 has a short detection circuit 130 and monitors [a short abnormality of] the electric power lines 12A an 12H, to detect short circuits. [With] By means of the short detection

circuit 130, for example, when a short [abnormally of] circuit is detected in the electric power line 12A, [is detected, such] a signal is inputted into the control circuit 170, [through an output signal line 170a] and the load power supply shutdown circuit 110 is driven through an output signal line 170a. [, and] In this manner, an end portion of the shortened electric power line section 12A [having the short abnormality] is contacted and separated.

[In] At this time, the control circuit 170 sends a signal which specifies the electric power line section having the short abnormality to other modules through the communication circuit 140. The control circuit of the BCM module 14, which has received the [above stated] latter signal, drives the load power supply shutdown circuit 210 through the output signal line 270a. Accordingly, [and accordingly] another end portion of the electric power line 12B which is connected through the electric power line 12A and the connector 17A is released.

Under the above stated condition, [to the respective loads,] power is supplied to the respective loads according to [the] a tree connection [line which are] comprised of the main line having the battery 3, the fuse 4e, the load power supply shutdown circuit 110 of FIM module 5, the electric power lines 12H and 12G, [and] the load shutdown circuit 310 having BCM module 14, and the sub-lines 23, 24 and 50f which are wired from the power

supply circuit 200 of BCM module 14[, the power is supplied to the respective loads].

Fig. 3 shows the [a] construction of another embodiment. The portions which differ from the construction shown in Fig. 2 will be explained.

[In] Fig. 2[, the separate system] shows a power supply system which has [the] separate [function] functions, except for the body electric component system. However, [is shown, however] in the embodiment shown in Fig. 3, [the] power is supplied [supply supplying] to the power train control module (PCM) 10 and ABS control unit 11 [is carried out] from the power supply [supplying] circuit 100 of FIM 5 which is arranged in the same engine [room] space, while power supply is supplied [and] to the radio 15, [and] the SDM 25, and A/C unit 16, [the power supply is supplied] from the power supply [supplying] circuit [100] 200 of BCM 14, which is arranged in the same cabin.

As stated [in] above, it [can be dispensed] is possible to dispense with the fuses 36a, 36b, 36c, 36d and 36e shown in Fig. 2, which are connected in parallel to the respective power supply [supplying line] lines. The[, the] electric power line between [from] the battery 3 and the respective modules [is passed] passes through from the battery 3 which is arranged in the engine [room] compartment to the ignition key which is arranged in the

passenger cabin, and the fuse box. However, [however] the electric power line is [connected] closed by FIM 5 and BCM 14. In this manner, the electric power line can be shortened and a number of the electric power lines can be deleted.

Fig. 4 shows [a] the construction of a further embodiment. [The] Those portions which differ from the construction shown in Fig. 2 will be explained.

In Fig. 2, the modules which [is] are connected to the power bus 12 are three: [which are] the FIM 5, the BCM 14 and the RIM 9[, in]. In Fig. 4, the power train control module (PCM) 10 (which is [the control system module having the separate function except for] functions separately from the body electric component system), ABS control unit 11, and A/C unit 16 are connected to the power bus 12.

Accordingly, the power bus is comprised of FIM 5, an electric power line 12A1, ABS 11, an electric power line 12A2, a connector 17A, the electric power line 12B, BCM 14, the electric power line 12C, a connector 17B, the electric power line 12D, RIM 29, the electric power line 12E, a connector 17C, the electric power line 12F, A/C unit 16, the electric power line 12G, a connector 17D, an electric power line 12H2, PCM 10, an electric power line 12H1, and FIM 5.

Further, [to the power train control module (PCM) 10, ABS control unit 11,] A/C unit 16, and the control system power supply, which are connected to the power train control module (PCM) 10, ABS control unit 11, are [is] supplied through the [respective] fuse 4g, the fuse 4a, the fuse 4h and further the multiple communication line 30 is connected. The power supply [supplying] to DDM is altered from BCM 14 to A/C unit 16.

In the same manner as [As] stated [in] above, [it can be dispensed with] the fuses 36a, 36b, 36c, 36d and 36e shown in Fig. 2, which are connected in parallel to the respective power supply [supplying] line, can be dispensed with. [the] The electric power line between [from] the battery 3 and the respective modules [is passed through] passes from the battery 3 [which is] (arranged in the engine [room] compartment) to the ignition key, which is arranged in the cabin, and the fuse box[, however]. However, the electric power line is [connected] closed by FIM 5 and BCM 14[,]. In this manner, the electric power line can be shortened and a number of the electric power lines can be deleted. [Further] Furthermore, in comparison with the structure shown in Fig. 3, the power supply [supplying] circuit to FIM 5 and BCM 14 can be simplified.

Fig. 5, Fig. 6, Fig. 7, Fig. 8, and Fig. 9 are the constructions of the embodiment shown in Fig. 2.

For convenience of explanation in depicting [The expression of] a semiconductor switching element [which is stated] in the drawing of the present specification hereinafter, [in a convenience for the explanation,] generally a symbol [for] indicating [the] a transistor [expresses] represents a semiconductor switching element having no short protection function, [and on the other hand] while a symbol [for] indicating a MOSFET [expresses] represents a semiconductor switching element having a short protection function.

The construction of FIM 5 will be explained referring to Fig. 5. The load power supply shutdown circuit 110 shown in Fig. 2 is constituted by a first load power supply shutdown circuit 110a and a second load power supply shutdown circuit 110b. The first load power supply shutdown circuit 110a, in turn is constituted by a relay 111, [and] a diode 113, and a semiconductor switching element 115. The second load power supply shutdown circuit 110b on the other hand is [constituted with same of] similar to the first load power supply shutdown circuit 110a and is constituted by a relay 112, [and] a diode 114, and a semiconductor switching element 116.

In these relays 111, 112, when the current flows into the coil[, then a] the [contact present] contacts are in an "on" state and when the current is [performed the shutdown] interrupted[, then] the contact present an "off" state.

Since the operation and the detailed construction of the first and the second load power supply shutdown circuits 110a and 110b are same, [it] they will be explained by the first load power supply shutdown circuit 110a. The semiconductor switching element 15 is driven to the "on" state and the "off" state, according [According] to the control signal from the control circuit 170, [since the semiconductor switching element 115 is presented to the "on" state and the "off" state, a] so that the contact [point] points of the relay 111 [is presented] are driven to the "on" state and the "off" state.

In [a case of non-existence] absence of the diode 113, when the battery 3 is connected reversely, a reverse current flows to the coil of the relay 111, [a reverse current flows] and the contact [point] points of the relay 111 [is presented to] are in the "on" state without reference to [the relationship of] the control signal, [and then to the load the] so that a current flows to the load in a [reversal] reverse direction in a normal time of the load, and [an error] incorrect operation [is carried out, however by providing the] occurs. The diode 113, [not to] prevents such a flow of [the] reverse current to the coil of the relay 111, and the contact [point] points of the relay 111 [is performed to carry out to present] are maintained in the "off" state. Thus, [As stated above, by the provision of the diode 113, even when the battery 3 is reversely connected, since the relay presents the "off" state, since the current passage line of the

load is performed the shutdown, the error] a failure [operation] in which operation of the load [is operated and] is continued can be prevented.

The power supply [supplying] to the coil of the relay 111 is connected to the control system power supply explained in Fig. 2. One side [, on an end portion of the contact point] of the relay 111 is connected to the battery 3 through the fusible link 4f, while the other [and another] end [portion] is connected to the loop system power supply [supplying system electric power] line 12A, [at the same time it is connected] and to the output circuit 160 for supplying [the] power [supply supplying] to the load.

As stated [in] above, [the] power [supply] is supplied to the coil of the relay 111 [is carried out] from the control system power supply, as well as [and further] the power supply [supplying] to the control 170 for outputting the control signal of the coil[, even]. Even if the power bus 12 [is carried out the fail, and the] fails, control of the relay Ill is carried out, and accordingly the shutdown and connection of the first load power supply shutdown circuit 110a can be carried out.

Further, it is unnecessary to operate the load, and when the current is [tried] to be reduced [reduce] etc., the current [for flowing] in the relay 111 is [performed the] shutdown[, since].

Thus, the power supply [for supplying] to the load can be [performed the shutdown] shut down, and [the consumption] current consumption can be lessened.

[Further, in reversely,] On the other hand, when the control system power supply [becomes the fail] fails, the current of the relay 111 is [performed the shutdown,] interrupted and the load power supply [shutdown] circuit 110a is [performed the shutdown, and since] shut down. Since the latter supplies power [supply is supplied] to the load, even if the control circuit [is carried out the error operation] malfunctions, all of the loads [become to present to] are placed in a stop condition, and [then the error] erroneous operation [can not be carried out] is prevented.

The output circuit 160 is constituted by semiconductor switching elements 163 - 168 which carry out [the] drive control by supplying [the] power [supply] to the over-current detection circuits 161 and 162 and the loads. In this embodiment, [as] the semiconductor switching elements 163 - 168 comprise power [MOSFET] MOSFET's which [is installed] have an over-temperature detection shutdown function. (When and [in an interior portion is used, and when the] over-current flows and the temperature of the element [becomes to more than] exceeds a predetermined [temperature] value, it [presents to] enters an "off" state.) Accordingly, even when the load [becomes the] is short circuited, [the] current does not continue to flow[, and further] . Further,

when the harness [is invited the smokes and] overheats, the fuse [is broken down, further] blows, so that the battery does not [present the over-discharge] over-discharged.

Although only [Only] six semiconductor switching elements are shown in the figure, naturally the number of the elements can be increased [and] or decreased according to the loads which are connected to FIM 5.

[To the semiconductor switching elements 163, 164 and 165,] As shown in Fig. 5, of the load 190 which is connected to FIM 5, a washer motor 191, a right turn lamp [right] 7a, and a right head lamp [right] 6 which are arranged [respectively] at [a] the right side of a vehicle are connected respectively to the semiconductor switching elements 163, 164 and 165. [of the load 190 which is connected to FIM 5. To the semiconductor switching elements 166, 167 and 168, a] A horn 8, a left turn lamp [left] 2a, and a left head lamp [left] 1 which are arranged [respectively] at [a right] the left side of a vehicle [of the load 190 which is connected to FIM 5] are connected respectively to the semiconductor switching elements 166-168. [Further,] The other ends of the semiconductor switching elements 163[, 164 and] - 165 are connected to the over-current detection circuit 161, [and to another end of an upstream of the over-current detection circuit 161, the] to which power [supply] is supplied [from] by

the second load power supply shutdown circuit 110b, situated upstream thereof.

Similarly, the [The] other ends of the semiconductor switching elements 166[, 167 and] - 168 are connected to an over-current detection circuit 162, [and to another end of an upstream of the over-current detection circuit 162 the] to which power [supply] is supplied [from] by the first load power supply shutdown circuit 110a, situated upstream thereof.

As stated [in] above, separate systems are formed on [in] the right [side] and [the] left [side] sides of the vehicle, [the separate systems are formed,] and even if any one of the separate systems [becomes the fail] fails, another separate system can be operated. Herein, the reason why the separate system is formed at the right side and at the left side is that [to FIM 5,] many loads connected to FIM 5 are constituted by pairs [one pair] at the right [side] and [the] left [side,] sides (for example, the head lamp, the fog lamp, the clearance lamp etc.) [are connected]. For example, when [the] power [supply] is supplied to the [head lamp] right and [the] left head [lamp left according to] lamps via the same power supply system, [and when] if the over-current detection circuit of [this] that power supply system [becomes the fail and] detects a failure, the power supply is [not supplied, since] cutoff to both the head lamps at the right

side and the left side [is righted out, it]. This is very [danger] dangerous during a night running.

However, as shown in this embodiment, since [the] two separate systems are constituted, one at the right side and one at the left side, [since] one of the head lamps is [righted] remains on, and [then] the worst circumstance can be avoided.

The control system power supply circuit 120 is constituted by a diode 122, a constant voltage power supply circuit 121, and a power supply shutdown circuit. [The control system power supply which is supplied] Power from the battery 3 [through the fuse 4b] supplies [to] the constant voltage power supply circuit 121 via the fuse 4b and the diode 122.

[In the] The constant voltage power supply circuit 121[, it is generated] generates a constant voltage which operates the control circuit 170 for [carrying out] executing the various kinds [executions and the] of control processing. This voltage is supplied to a voltage application drive circuit 131 of the short detection circuit 130, as well as to [and] the control 170, the communication circuit 140, and the power supply shutdown circuit 123.

In the power supply shutdown circuit 123, [according to the control signal of the control circuit 170,] the constant voltage

power supply [which is supplied] from the constant voltage power supply circuit 121 is supplied [and is performed the shutdown] to the input circuit 150, or is cut off according to a control signal of the control circuit 170. The input circuit 150, in turn, converts the [signal] signals of the atmospheric temperature sensor 181 [of the input signal 180] and the brake liquid [amount] volume sensor 182 etc. to [the] a voltage level [in] which [the above stated signal is] can be taken into the control circuit 170, by means of pull-up [Accordingly, by] resistors 151 and 152[, it is carried out to a pull-up]. However, when [the man does not ride on] no one rides in the vehicle and [the vehicle] it is left alone, according to the information from the brake liquid amount sensor 182 and the atmospheric temperature sensor 181, [in] (regardless of the necessity for alarming the alarm etc.), via the pull-up resistors 151 and 152, when [the] a current flows [into] in the brake liquid [amount] volume sensor 182 and the atmospheric temperature sensor 181, the battery 3 is discharged and [then the battery 3 comes to an end] depleted.

Accordingly, [in a case of the unnecessity,] when it is unnecessary to warn the driver, the power supply [for supplying] to the pull-up resistors is [performed the shutdown according to] shut down via the power supply shutdown circuit 123.

The short detection circuit 130 is constituted by a voltage application drive circuit 131, pull-up resistors 132 and 135, and pull-down resistors 133, 134 to the ground. The voltage application drive circuit 131 [carried out to an "on" state and an "off" state of] connected and disconnects the power supply supplying to the pull-up resistors 132 and 135 according to the control signal of the control circuit 170. The pull-up resistor 132 and [another] the other end of the pull-down resistor 133 are connected to [an outside of FIM 5 through a connection use] external connector for [the] use outside of FIM 5, and further are connected to a short sensor of the electric power line 12H.

Further, [in an interior portion of] within FIM 5, the control signal is inputted to the control circuit 170. Similarly, [to] the pull-up resistor 135 and [another] the other end of the pulldown resistor 134 are connected to an [outside of FIM 5 through a connection use] external connector for [the] use outside of FIM 5, and further are connected to a short sensor of the electric power line 12A.

Further, in an interior portion of FIM 5, the control signal is inputted to the control circuit 170. [Further, in an interior portion of FIM 5, the control signal is inputted to the control circuit 170.]

[As stated in above, the] The reason why the pull-up resistor 135 and [another] the other end of the pull-down resistor 134 are connected to the outside of the FIM 5 through [a connection use] an external connector [for the outside of FIM 5] is as [following] follows: [As stated in above, since] When the [another] other end of the short sensor becomes [the] open [state] circuited, commonly the current does not flow into the short sensor. In this case, since the current does not flow into the [connection use] external connector, the connection portion is oxidized and there is a possibility of a contact [fail] failure.

Accordingly, with the construction in this embodiment, since the current flows to the connector [the current flows] through a [rout passage] route comprised of the pull-up resistor 135, the two connection connectors, and the pull-down resistor 134, [the] oxidation can be prevented. The operation will be explained in detail [in a latter portion] later.

Fig. 6 [is a] shows the construction [view] of BCM 14. The first and second load power supply shutdown [circuit] circuits 210a [shown in Fig. 2] and [the second load power supply circuit] [201b] 210b have the same constructions [of] as the first and second load power supply shutdown [circuit] circuits 110a [shown in Fig. 2 and the second load power supply circuit] and 110b, shown in Figure 5.

[The power supply supplying of a] Power is supplied to the coil of a relay 211 [is connected to] from the control system power supply. [and one] One [end of a] contact of the relay 211 is connected to the loop system [power supply supplying system] electric power line 12B and [another] the other end is connected to the loop system [power supply supplying system] electric power line 12C. At [and] the same time, both ends are connected to the power supply [supplying] circuit 200 [for supplying the power supply to the loads] or the output circuit 260.

Although the [The] output circuit 260 and the power supply [supplying] circuit 200 have the [differ] different names, [however since the] their function[, the] and construction are the same, [it] and will be explained simultaneously. They [The output circuit 260 and the power supply supplying circuit 200] are constituted respectively by the over-current detection circuits 261, 262, 201 and 202 and the semiconductor switching elements 263-266, 203 and 204 for [carrying out the drive by] supplying [the] power [supply] to the loads.

In this embodiment, [as] the semiconductor switching elements 263-266, 203 and 204[, the] are power [MOSFET to] MOSFET's which have an [the] over-temperature detection shutdown function. [is installed is used, and when the] (When an over-current flows and the temperature of the element [becomes more than] a predetermined [temperature] value, it [presents to]

exceeds an "off" state.) Accordingly, even when the load [becomes the] is short circuited, [the] current does not [to] continue to flow[, and further]. Further, if the harness [is invited the smokes and] overheats, the fuse [is broken down, further] blows, so that the battery does not [present the] over-discharge.

[Only] Although only six semiconductor switching elements are shown in the figure, naturally the number of the elements can be increased [and] or decreased according to the loads which are connected to FIM 5.

[To the] The semiconductor switching elements 263 and 264[,] are connected to the room lamps 293 and 294 of the load respectively, which are connected to BCM 14 [respectively]. [To another end] The other ends of the semiconductor switching elements 265 and 266[,] are connected to warning lamps 291 and 292 of the load 290, which are arranged an instrument panel [of the load 290 which is] and are connected to BCM 14 [are connected].

[To the semiconductor switching element 203,] DDM 18, which is arranged [to] on the driver seat door, is connected to the semiconductor switching element 203, and [to the semiconductor switching element 204,] PDM 20, which is arranged [to] on the

passenger seat door, is connected to the semiconductor switching element 204.

[Further,] The other ends of the semiconductor switching elements 263 and 264 are connected to the over-current detection circuit 261, [and to another end of an upstream of the over-current detection circuit 261, the] to which power [supply] is supplied [from] by the second load power supply shutdown circuit 110b situated upstream thereof from the electric power line 12F.

[The] Similarly, the other ends of the semiconductor switching elements 265 and 266 are connected to an over-current detection circuit 262, [and to another end of an upstream of the over-current detection circuit 262 the] to which power [supply] is supplied [from] by the first load power supply shutdown circuit 110a, situated upstream thereof, from the electric power line 12C.

The other [ends] end of the semiconductor switching element 203 is connected to the over-current detection circuit 261, [and to another end of an upstream of the over-current detection circuit 201 the] to which power [supply] is supplied [from] by the first load power supply shutdown circuit 110a, situated upstream thereof, from the electric power line 12G.

The other [ends] end of the semiconductor switching element 204, on the other hand, is connected to the over-current detection circuit 202, to which [and to another end of an upstream of the over-current detection circuit 202 the] power [supply] is supplied [from] by the first load power supply shutdown circuit 210a, upstream thereof, from the electric power line 12B.

[As stated in] From the above, it is apparent that separate systems are formed on [in] the right [side] and [the] left [side] sides of the vehicle. [the separate systems are formed] Thus, even [any] if one of the separate systems [becomes the fail] fails, [another] the other separate system can be operated.

The control system power supply circuit 220 has the Same construction and [the same] operation. [with] as the control system power supply circuit 120 of FIM 5 shown in Fig. 5. The input circuit 250 converts the signals from the intermittent wiper [volume] rate 282, [of the input Signal 280,] the wiper Switch 283, the light switch 281, and the ignition key switch (not shown in Fig. 6) etc. to [the] a voltage level [in] which [the above stated signals are] can be taken [in] into the control circuit 270, by means of [Accordingly, the] pull-up [function is added by the] resistors 251, 252 and 253. [According to the input signals of the intermittent wiper volume 282 and the wiper switch 283, since] Since the load to be controlled by the input signals

of the intermittent wiper rate 282 and the wiper switch 283 operates necessarily only when the ignition switch is [presented to the] "on" [state], [when the man does not exist] with no one in the vehicle, and the vehicle is left alone, [since] it is unnecessary to take in [the] this information[,]. Therefore, the power supply [which is supplied] to the pull-up resistors 251 and 252 is shutdown by the power supply [shutdown] shut down circuit 123.

On the other hand, when [the man does not exist in] the vehicle [and the vehicle] is unoccupied and is left alone, [since] if the light switch 281 and the ignition switch etc. are suddenly turned [presented to the] "on", [state, and due to fact since] because it is necessary to drive the load[,] even when [the man does not exist] no one is in the vehicle, [and the vehicle is left alone,] it is necessary always to detect the input condition. Accordingly, the power supply [supplying of] to the pull-up resistor 253 is continuously connected to the output of the constant voltage power supply circuit 221, [in which the] so that power [supply supplying] is [carried out] always supplied.

The short detection circuit 230 is connected to four short sensors of the electric power line 12B, the electric power line 12C, the electric power line 12F, and the electric power line 12G.

Fig. 7 [is a] shows the construction [view] of RIM 29. The construction of the load power supply shutdown circuit 310 is the same [construction of the construction] as that of the load power supply shutdown circuit 110a of FIM 5 shown in Fig. 5; and the power supply [supplying] of [a] the relay 311 to a relay coil is connected to the control system power supply, as explained in Fig. 2.

[A] One contact of the relay 311 is connected to the loop system [power supply supplying system] electric power line 12D and [another] the other end is connected to the loop system [power supply supplying system] electric power line 12E. At [and at] the same time, [the] both [two] ends are connected to the output circuit 360 for supplying [the] power [supply] to the loads.

The output circuit 360 is constituted by semiconductor switching elements 364 - 368 which [carry out the drive control by supplying the] supply power [supply] to the over-current detection circuits 361 and 362 and the loads.

In this embodiment, [as] the semiconductor switching elements 364, 365, 367 and 368[, the] are power [MOSFET] MOSFET's which [is installed] have an over-temperature detection shutdown function. [in an interior portion is used, and when] (When an [the] over-current flows and the temperature of the element

[becomes to more than] exceeds a predetermined [temperature] value, it [is presented to an] turns "off" [state]). Accordingly, even if the load [becomes the short, the] is shorted, current does not continue to flow[, and further]. Further, if the harness [is invited the smokes and] overheats the fuse [is broken down, further] blows, so that the battery does not [present the] over-discharge.

Although [only] six semiconductor switching elements are shown in the figure, naturally the number of the elements can be increased [and] or decreased according to the loads which are connected to RIM 29.

[To the] The semiconductor switching elements 363, 364 and 365[,] are connected respectively to a power window motor 391 of a rear seat right side door [of the load 390 is connected to RIM 29], a fuel pump 392 (which is arranged at a right side of the trunk) [room], a stop lamp right 393 etc., which are connected to RIM 29. [To the] The semiconductor switching elements 366, 367 and 368, on the other hand are connected respectively to a power window motor 394 of a rear seat left side door [of the load 390 is connected to RIM 29], a fuel pump 395 [which is] (arranged at a left side of the trunk) [room], and a stop lamp left 396 etc., which are connected to the RIM 29.

[Further,] The other ends of the semiconductor switching elements 363, 364 and 365 are connected to the over-current detection circuit 361, [and to another end of an upstream of the over-current detection circuit 361,] to which the power [supply of] is supplied by the load power supply shutdown circuit 310, situated upstream, [is supplied] from the electric power line 12D.

[The] Similarly, the other ends of the semiconductor switching elements 166, 167 and 168 are connected to an over-current detection circuit 162, to which [and to another end of an upstream of the over-current detection circuit 162 the] power [supply of] is supplied by the load power supply shutdown circuit 310, [is supplied] from the electric power line 12D.

[As stated in] From the above, it is apparent that separate systems are formed on [in] the right [side] and [the] left [side] sides of the vehicle. [the separate systems are formed,] Thus, even [any] if one of the separate systems [becomes the fail] fails, [another] the other separate system can be operated.

[Herein, the] The reason why [the] separate [system is] systems are formed at the right [side] and [at the] left [side] sides is that [to RIM 29], many of the loads connected to RIM 29 are constituted by [one pair] pairs at the right [side] and [the] left [side] sides, for example, the stop lamp, the table lamp

etc.[. For example, when] When [the] power [supply] is supplied, for example, to the stop lamp left 396 and the stop lamp right 393 [according to] via the same power supply system, and [when] the over-current detection circuit of [this] power supply system [becomes the fail and the] detects a failure, so that power supply is [not supplied, since the] cut off. Since both stop lamps [at the right side and the left side is righted out during the brake, it] are disconnected, braking is very [danger] dangerous.

However, as shown in this embodiment, since [the] two separate systems are constituted at the right [side] and [the] left [side] sides, one of the head lamps [is righted on] remains lit and the worst circumstance can be avoided. The semiconductor switching elements 363 and 366 [is] form an H bridge circuit which drives the motor [toward the] in both normal and reverse directions[,]; such a construction will be explained [in a latter portion] later.

The control system power supply circuit 320 has the same construction and [the same] operation [with] as the control system power supply circuit 120 of FIM 5 shown in Fig. 5. The input circuit 350 converts the voltage [in] level at which the control circuit 370 takes in the signals from the door opening and closing switch 382 of the input signal 380 and the rear seat power window switch 383 etc.[.] by means of pull-up [Accordingly,

the] resistors 351 and 352. [are formed to make the pull-up.] When the [man does not exist in the] vehicle is unoccupied and [the vehicle] is left alone, [since] it is unnecessary to take in [the] this information[,]. Therefore, the power supply [which is supplied] to the pull-up resistors 351 and 352 is shutdown by the power supply shutdown circuit 323.

The short circuit 330 is connected to two short sensors of the electric power line 12D and the electric power line 12E.

Fig. 8 [is] shows the construction of PCM 10 in which the power supply is supplied [according to] by another system against the loop [shape] power supply [supplying] system. PCM 10 [according to embodiment shown] in Fig. 2 is constituted by a power supply circuit 720, a control circuit 770, an input circuit 750, and an output circuit 760.

The power supply circuit 720 is constituted by a diode 722, and a constant voltage power supply circuit 721. [The power] Power [supply which is supplied] from the battery 3 is supplied via the fuse 4a, the ignition switch 26a, and the fuse 36b [is supplied] to the constant voltage power supply circuit 721 [via] (the diode 722), [on the other hand as the load drive use power supply the power supply is supplied] and to the semiconductor switching elements 761 and 765 of the output circuit 760.

[In the] The constant voltage power supply circuit 721[,] generates the constant voltage which operates the control circuit for [carrying] performing the various [kinds executions] functions, [the] control processing etc. [is generated.] The input circuit 750 converts signals from the crank angle sensor 781, the air flow sensor 782, and the throttle sensor 783, etc. to [the] a voltage [in] which can be input to the control circuit 770. [takes into the signals from the crank angle sensor 781, the air flow sensor 782, and the throttle sensor 783, etc..]

The output circuit 760 is constituted by semiconductor switching elements 761 and 765 which perform [carry out the] drive control by supplying [the] power [supply] to the loads, and semiconductor switching elements 762, 763 and 765 which [carry out] perform the "on" and "off" switching operations of the loads.

In this embodiment, [as] the semiconductor switching element 765[, the] is a power MOSFET which [is installed] has an over-temperature detection shutdown function. [in an interior portion is used, and] Thus, when the over-current flows and the temperature of the element [becomes to more than] exceeds a predetermined [temperature] value, it [is presented to an] turns "off" [state].

Accordingly, even if the load [becomes the short, the] is shorted, current does not continue to flow. Further, if [, and further] the harness [is invited the smokes] overheats and the fuse [is broken down, further] blows, that the battery does not [present the] over-discharge.

On the other hand, [as] the semiconductor switching elements 762, 763 and 765 [a] are simple semiconductor switching [element is used] elements. [Because,] If the load [becomes the] is short circuited and [the] current flows, [since] the fuse which is arranged [at the] upstream of the load is [welded, the] blown, and an over current does not continue to flow.

In this embodiment, [the] a semiconductor switching element having no protection function is used[,]; naturally there is no problem in which the semiconductor switching element having [the] a protection function is used.

[Only] Although five semiconductor switching elements are shown in figure, naturally a number of the semiconductor switching element can be increased [and] or decreased by the loads which are connected to PCM 10.

[To the] The semiconductor switching elements 762, 763 and 764[,] are connected respectively to a warning lamp 792 [of the load 790 which is connected to PCM 10], an injector 793, and the

EGR solenoid 794 which are included in the load 790 which is connected to PCM 10. [are connected, and at the upstream] Upstream of these elements [the] fuses 36f, 36g and 36h are connected. [To the] The semiconductor switching element 761[,] is connected to the AT solenoid 791 of the load 790, which is connected to PCM 10 etc. [are connected.]

The semiconductor switching element 765 [is] constitutes H bridge circuit which drives the motor [toward the] in both [normal] forward and reverse directions[, such a]; its construction will be explained [in a latter portion] later.

Similarly to PCM 10, the ABS 11[,] is included in the separate system with the loop shape power supply [supplying] system shown in Fig. 2[, the explanation about of the constructions]. The construction of the ABS 11, A/C 16, SDM 25[,] and the radio 15 are substantially [to] the same [of] as PCM 10 shown in Fig. 8. Naturally, [will be omitted, naturally] the input signals and the loads which are connected to the modules differ.

Fig. 9 shows [a] the construction view of DDM 18 [in] to which [the] power [supply] is supplied [to] from the power supply [supplying] circuit 200 of BCM 14.

DDM 18 is constituted by a power supply circuit 620, a communication circuit 670, [and] a part of an output circuit 660 and a part of the loads 690.

The power supply circuit 620 is constituted by a constant voltage power supply circuit 621 and a power supply shutdown circuit 623. [The power supply which] Power is supplied from the constant voltage power supply circuit 621 and the power supply shutdown circuit 623.

[The power supply which is supplied] Power from the power supply [supplying] circuit 200 [from] of BCM 14 is supplied to the constant voltage supply circuit [721 and one other] 621 on the one hand, and [as the load use drive use power supply,] to the switching elements 663, 664, and 665 and the load 691 as the load drive power supply on the other hand [is supplied].

[In the] The constant voltage Power supply circuit 621[, the] provides a constant voltage for [operating] performing the various kinds of executions, and [the] for control processing. [is generated. In the] The input circuit 650[, it is converted] converts the signals from the power window switch 681 and the door lock switch 682 to [the] a voltage [for taking into the signals from the power window switch 681 and the door lock switch 682] which can be processed in the CPU 670.

[Accordingly, these switches] When the vehicle is left unoccupied, it is not unnecessary to take [into] in the information from these switches. [when the man does not exist in the vehicle and the vehicle is left alone,] Therefore, the power supply [which is supplied] to the pull-up resistors 651 and 652 is [performed the shutdown according to] shut down by the power supply shutdown circuit 621.

The output circuit 660 is constituted by semiconductor switching elements 663, 664 and 665, which [carry out the drive control by supplying the] supply power [supply] to the loads, and by semiconductor switching elements 661 and 662 which [carry out] switch the loads "on" and "off" [operations of the loads].

In this embodiment, [as] the semiconductor switching elements 661 and 662[, a] are simple semiconductor switching elements [are used].

[Accordingly, even] Even when the load [becomes the short] is shorted, and [the] an over-current flows, since the power supply [supplying] circuit 200 of BCM 14 has [the] a protection function, the current [does not continue to] flow is discontinued. [In] Therefore, in this embodiment, although the semiconductor switching [element having] elements have no protection function [is used and however] there is no problem.

[in which the semiconductor switching element having the no protection function is used].

The switching elements 663, 664 and 665, which drive [for driving] the power window motor 693, the door lock motor 694, the mirror motor 695, use [the] a relay[,]; however, [the] a semiconductor switching element can also be [employed] used.

[To the] The semiconductor switching element 661[,] is connected to a switch mirror lamp 691 [of the load which is installed in the interior portion of] in DDM 18; [is connected to,] and [to] the semiconductor switching element 662[,] is connected to a step motor which is installed [to] in the door [is connected, and at the upstream of these loads the]. The power supply [supplying] circuit 200 of BCM 14 is connected upstream of these loads.

Since the construction of PDM 20 is substantially [to] the same as that of DDM 18 shown in Fig. 9, a detailed [the] explanation will be omitted.

[As stated in above, since] Since [the] power [supply] for DDM 18, PDM 20 and the loads which are installed on the door is supplied from the power supply [supplying] circuit having [the] a protection function of BCM 14, [as the power supply supplying wire] it is unnecessary to use [the] coaxial cable [structure

wire shown] (such as Fig. 26)[, however] for this purpose; rather, an ordinary wire can be used, and[. Accordingly,] the diameter of the wire can be [formed] thin. Further, [as] the semiconductor switching element used in the output circuit, [it can be employed the element having no] does not need to have a protection function.

Fig. 10, Fig. 11 and Fig. 12 [are] show the construction [views] of FIM 5, BCM 14 and PCM 10 according to the embodiment shown in Fig. 3[, however there]. There are no changes in the other modules RIM 29, DDM 18 and PDM 20 [against] relative to the embodiment shown in Fig. 2.

The construction of FIM 5 according to the embodiment shown in Fig. 3 will be explained according to Fig. 10. Only the [different] points [against to] which differ from the construction of FIM 5 according to the embodiment shown in Fig. 5 will be explained.

In Fig. 2, [the] a separate [system] power supply system having [the] a separate function is formed for every control system except for the body electrical component system. [is formed every the control system each, however the construction according to] However, in the embodiment shown in Fig. 3, [the] power is supplied [supply] to PCM 10 and ABS 11 [is supplied] from FIM 10, which is arranged in the same engine [room]

compartment. Accordingly, compared to FIM 5 shown in Fig. 5, a power supply [supplying] circuit 100 is added [against FIM 5 shown in Fig. 5].

The semiconductor switching element 102 of the power supply [supplying] circuit 100 receives [the supply of the] power [supply] via an over-current detection circuit 162 and controls the supply of [the] power [supply] against PCM 10[,]; and the semiconductor switching element 101 receives the supply of the power supply via an over-current detection circuit 161 and controls the supply of the power supply against ABS 11.

As stated [in] above, it [can be dispensed] is possible to dispense with the fuses 36a, 36b, 36c, 36d and 36e shown in Fig. 2, which are connected in parallel to the respective power supply [supplying] line[,]. The [the] electric power line between [from] the battery 3 and the respective modules [is passed through] passes from the battery 3 [which is] (arranged in the engine [room] compartment) to the ignition key, which is arranged in the cabin, and the fuse box[, however]. However, the electric power line is [connected] closed by FIM 5 and BCM 14[,]. In this manner, the electric power line can be shortened and a number of the electric power lines can be deleted.

The construction of BCM 14 [according to] in the embodiment shown in Fig. 3 will be explained according to Fig. 11. Only

those [the different] points [against] which differ relative to the construction of BCM 14 [according to the embodiment shown] in Fig. 6 will be explained.

In Fig. 2, [the] a separate [system] power supply system having the separate function is formed for every control system except for the body electrical component system [is formed every the control system each]. However, [however the construction according to] in the embodiment shown in Fig. 3, [the] power is [supply] supplied to the radio 15, SDM 25 and A/C 16 [is supplied] from BCM 14, which is also arranged in the [same] cabin of the vehicle, via the power supply circuit 200, and [. To the radio 15, SDM 25 and A/C 16, the supply of the power supply] is controlled according to the semiconductor switching elements (not shown) [in figure to the power supply supplying circuit 200].

As stated [in] above, it [can be dispensed] is possible to dispense with the fuses 36a, 36b, 36c, 36d and 36e shown in Fig. 2, which are connected in parallel to the respective power supply [supplying wire, the] line. The electric power line between [from] the battery 3 and the respective modules [is passed through] passes from the battery 3 [which is arranged] (in the engine [room] compartment) to the ignition key, which is arranged in the cabin, and the fuse box[, however] . However, the electric power line is [connected] closed by BCM 14[,] . In this manner,

the electric power [wire] line can be shortened and a number of the electric power lines can be deleted.

The construction of PCM 10 [according to] in the embodiment shown in Fig. 3 will be explained referring to Fig. 12. The construction of PCM 10 is the same shown in Fig. 8[,]; however, the power supply [supplying] of PCM 10 and the loads is altered from FIM 5.

Fig. 13 and Fig. 14 [are] show the construction [views] of the modules BCM 14 and PCM 10 according to the embodiment shown in Fig. 4[, however there]. (There are no changes in the other modules FIM 50, RIM 29, DDM 18 and PDM 20 [against] compared with the embodiment shown in Fig. 2.)

The construction of BCM 14 [according to the embodiment shown] in Fig. 4 will be explained [according] with reference to Fig. 13. Only [the different] those points [against to] which differ from the construction of BCM 14 [according to the embodiment shown] in Fig. 6 will be explained.

In Fig. 2, [the] three modules (FIM 5, BCM 14, RIM 29) are connected to the power bus 12 [112 are three which are FIM 5, BCM 14, RIM 29, however]. However, in Fig. 4 the control modules PCM 10, ABS 11 and A/C 16 (which have a [having the] separate function except for the body electrical component system) [which

are PCM 10, ABS 11 and A/C 16 is] <u>are also</u> connected to the power bus 12.

Accordingly, [the] <u>two</u> electric power lines <u>(12B and 12C)</u> <u>are</u> connected to BCM 14<u>;</u> [are two which are the electric power line 12B and the electric power line 12C and the] <u>(The</u> electric power [line] <u>lines</u> 12F[, the electric power line] <u>and</u> 12G<u>,</u> which are connected <u>to BCM 14</u> in the embodiment shown in Fig. 2<u>,</u> are connected to A/C 16.<u>)</u>

[In company] <u>Together</u> with this variation, the connections of the short sensor [become] <u>are reduced to</u> two from four<u>,</u> and [further] the construction of the power supply [supplying] circuit 200 and the loads to be connected are slightly altered[, however]<u>. However, because</u> there are no [alternations about] <u>alterations of</u> the basic construction and [the basic] operation, [the] <u>further detailed</u> explanation will be omitted.

As stated [in] above, it [can be dispensed] <u>is possible to dispense</u> with the fuses 36a, 36b, 36c, 36d and 36e shown in Fig. 2<u>,</u> which are connected in parallel to the respective power supply [supplying] line[, the]<u>. The</u> electric power line between [from] the battery 3 and the respective modules [is passed through] <u>passes</u> from the battery 3 [which is arranged] <u>(</u>in the engine [room] <u>compartment)</u> to the ignition key<u>,</u> which is arranged in the cabin, <u>and</u> the fuse box[, however]<u>. However,</u> the electric power

line is [connected] closed by BCM 14[,]. In this manner, the electric power line can be shortened and a number of the electric power lines can be deleted.

Further, in comparison with the construction shown in Fig. 3, the power supply [supplying] circuit of BCM 14 can be simplified.

The construction of PCM 10 [according to] in the embodiment shown in Fig. 4 will be explained referring to Fig. 14.

In Fig. 4, PCM 10 (which [is the control system module having the] has a separate function [except for] from the body [system] electric equipment system) is connected to the power bus 12.

The construction of PCM 10 [shown] in Fig. 14 differs from [the construction] that of RIM 29 which is connected to the power bus 12 [as shown] in Fig. 2, in respect [from the aspects] of the input signals to be connected and the electric power lines[, however]. However, the construction [has] is otherwise basically the same, and [construction. Accordingly, the] accordingly, a further detailed [constructions and the operation] explanation will be omitted.

Fig. 15, Fig. 16 and Fig. 17 [are] show other constructions (alternative to [of] Fig. 5. Fig. 6 and Fig. 7) of the respective [module] modules FIM 5, BCM 14 and RIM 29 according to the embodiment shown in Fig. 2. In Fig. 5, Fig. 6 and Fig. 7, [the] power [supply which] is supplied from [more than two] electric power lines 12A and 12H of the loop [system] power supply system which [is] are connected to the module, [is supplied] independently [respectively] to the respective loads. However, in Fig. 15, Fig. 16, Fig. 17, [the] power [supply which] is supplied from [more than two] electric power lines of the loop [system] power supply system [is supplied] to the loads in the interior portion of the module, by [performing the] means of a diode logical AND.

In FIM 5 shown in Fig. 15, for example, the power supply from the electric power line 12A and the electric power line 12H is supplied to the output circuit [by performing the] via a logical AND [in] circuit comprising a diode 117 and a diode 118.

In BCM 14 shown in Fig. 16, the power supply from the electric power [line] lines 12B and [the electric power line] 12C is supplied to the output circuit [by performing the] via a logical AND [in] circuit which includes a diode 217 and a diode 218; and [the] power [supply] from the electric power [line] lines 12F and [further the electric power line] 12G is supplied to the output circuit [by performing the] via logical AND [in]

circuit comprised of a diode 219a and a diode 219b. Similarly, in [In] RIM 29 shown in Fig. 17, the power supply from the electric power [line] lines 12D and [the electric power line] 12E is supplied to the output circuit [by performing the] via a logical AND [in] circuit in the form of a diode 317 and a diode 318.

With the above stated [constructions] construction, since the number of the power supply [supplying] systems is reduced, [the] a number of the over-current detection circuits which are disposed [at a] downstream can be deleted.

[In Fig.] Figs. 18[, Fig. 19, Fig. 20 and Fig.] - 21[,] show an H bridge circuit for driving the motor in both the forward and reverse directions. [of the normal rotation and the reversal rotation.]

First [of all], the construction shown in Fig. 18 will be explained. [Under] In response to two control signals, [from] the control circuit, [a] (logical circuit 1050) [converts to a control signal of] controls the H bridge, which is constituted by four semiconductor switching elements 1010, 1020, 1030 and 1040, and has [having] no short protection function. [Namely, during] During [the] normal forward rotation, the semiconductor switching elements 1020 and the semiconductor switching elements 1030 are [presented to the] turned "on", so that current flows

[state and] to [a] the motor 1060 [the current is flown,] in a first polarity; while [and] during [the reversal] reverse rotation, the semiconductor switching elements 1010 and the semiconductor switching elements 1040 are [presented to the] turned "on", so that a [state and it converts the signal for flowing the reversal] reverse current [into] flows in the motor 1060.

In [the construction shown in] Fig. 19, the [upstream side] two upstream semiconductor switching elements 1010a and 1020a which constitute H bridge [are formed with semiconductor switching elements 1010a and 1020a having the] have a short protection function; while [and] in [the construction shown in] Fig. 20, the downstream [side two] semiconductor switching elements 1030a and 1040a which constitute H bridge [are formed with semiconductor switching elements 1030a and 1040a having the] have a short protection function. Finally, [And] in the Construction shown in Fig. 21, [the upstream side and the downstream side] all of four semiconductor switching elements 1010a, 1020a, 1030a and 1040a which constitute H bridge [are formed with semiconductor switching elements 1010a, 1020a, 1030a and 1040a having the] have a short protection function.

In the construction [shown in] of Fig. 18, since the semiconductor switching elements [for constituting] of the H bridge have [not the] no short protection function, [at another

portion] it is necessary to [have the] provide a short protection function elsewhere.

In the construction [shown in] of Fig. 19, since the semiconductor switching [element having the] elements 1010a and 1020a have a short protection function at the upstream side, the apparatus is protected when the load [becomes the short the apparatus can be protected] is shorted and when the power supply [which is] connected to the load [becomes the short] is shorted to [the] ground[, the apparatus can be protected]. However, when the wire [which is] connected to the load [becomes the short] is shorted to the power supply side, then the semiconductor switching element at the downstream side is destroyed.

[On the contrary] In contrast to the above, in the construction [shown in] Fig. 21, since both the upstream and downstream semiconductor switching element [having the] have a short protection function, the apparatus is protected against all such short circuits; that is, [at the upstream side and the downstream side is used,] when the load [becomes the short the apparatus is protected, and further] is shorted when the power load [becomes the short the apparatus is protected and] is shorted when the wire [which is] connected to the load [becomes the short] is shorted to [the] ground, and when the apparatus [becomes the short] is shorted at the power supply side [and the apparatus can be protected].

The [use] manner of use of the four H bridges will now be explained. The module which receives the supply [of the] power [supply] from the power bus 12[, in concretely] (specifically at the upstream side of FIM 5, BCM 14 and RIM 29 in the embodiment shown in Fig. 2), there are only two fusible links 4e and 4f.

When the load [becomes the] is short circuited and [when the] no short protection function [does not exist] is provided in the output circuit, [since a] the whole loop [system] power supply system becomes [the operation becomes inability] inoperative. Therefore, it is necessary to use one of the constructions shown in Fig. 19, Fig. 20 and Fig. 21 as a motor drive H bridge circuit in FIM 5 (Fig. 5), BCM 14 (Fig. 6) and RIM 29 (Fig. 7)[, it is necessary to use any one of the constructions shown in Fig. 19, Fig. 20 and Fig. 21].

However, since PCM 10 (Fig. 8) and ABS 11, A/C 16 etc. according to the embodiment shown in Fig. 2 have [the] separate fuses for every [functions each] function and every [loads each] load (as shown in PCM 10 shown in Fig. 8), even [the apparatus has not] if the H bridge circuit [having the] has no short protection function, [since it does not present the] a fatal [fail] failure does not occur. Therefore, in [In] this embodiment, the H bridge circuit having no short protection function (shown in Fig, 18) is used. (Of course, there [is] would

also be no problem in [which] using the H bridge Circuits shown in Fig. 19, Fig. 20, Fig. 21) [are used].

Similarly to, in the power supply [supplying for] for DDM 18 and PDM 20, since [the] semiconductor switching elements having [the] a short protection function are used, the H bridge circuit comprising semiconductor switching element having no short protection function [shown in] (Fig. 18) is used.

In the embodiments shown in Fig. 4, since PCM 10, ABS 11 and A/C 16 are supplied [the supply of the] with power [supply] from the power bus 12, it is necessary to [arrange] use H bridge circuits having [the] a short protection function, such as shown in Fig. 19, Fig. 20 and Fig. 21, [used] in these modules. [In concretely,] Specifically, H bridge circuit shown in Fig. 20 is used as the circuit for driving the throttle motor[, H bridge circuit shown in Fig. 20 is used].

Next, the over-current detection circuits in the output circuits of the modules shown in [Fig. 5, Fig. 6, Fig. 7, Fig. 10, Fig. 11, Fig. 13, Fig. 14, Fig. 15, Fig. 16 and Fig. 17] Figs 5-7, 10, 11 and 13-17 will be explained.

Fig. 22 shows the construction of the over-current detection circuit. [An one end at the upstream side] A shunt resistor 2020 is connected to the electric power line at its upstream side, and

[one end at the downstream side shunt resistor is connected] to the plural semiconductor switching elements for driving the loads at its downstream side. [and further all] All [of] the currents which flow into the connected loads flow through this shunt resistor 2020.

A potential difference [between the both ends of] across the shunt resistor 2020 is amplified [according to] by an amplification circuit 2010 and the current which flows into the shut resistor 2020, [namely a] (the total [sum] of [the] all currents which flow into the connected load) [to be connected,] is detected [according to] by A/D converter 2000 of the control circuit.

In this embodiment, [in accordance with the detection of] by detecting the current, [the] a dead short [fail] failure of the load, [the] a leak short [fail] failure of the load, and a [the] complex [fail] failure including both a [of the] load dead short [fail] failure and [the] a dead short [fail] failure of the semiconductor switching element of the output circuit etc., [are] can be detected[, accordingly the]. Accordingly, fail-safe operation can be [carried out] achieved.

Using the flow charts shown in Fig. 37 and Fig. 38, the above stated [fail] failure detection [manner] and [the above stated] fail safe operation of [manner in] the modules will be

explained, referring to Figs. 5-7, 11, 13 and 14-17 [Fig. 5, Fig. 6, Fig. 7, Fig. 10, Fig. 11, Fig. 13, Fig. 14, Fig. 15, Fig. 16 and Fig. 17].

Fig. 37 shows the [above stated fail] failure detection [manner] operation of the load and a fail safe [manner] operation. Firstly, in a step 6000, the current IT which flows into the over-current detection circuit is measured by A/D converter 2000 shown in Fig. 22.

Next, in a step 6001, it is determined whether or not the current IT [which was measured is judged that whether the current] is more than a predetermined tolerance value [or not]. The above stated tolerance value is a [numeric] numerical value [that this value] which is less than a [value in] current at which [when the current flows more than the tolerance value,] any portion of the module is destroyed, and [this numeric value] is [established to be] more than the total operating current [value in] at which all loads connected to the module operate.

In the step 6010, when the current IT is [judged] less than the tolerance value, it is [judged] determined that there is no fatal dead short [fail] failure, and a step 6200 [shown in] (Fig. 38) is carried out, In the step 6010, when the current IT [is judged more than] exceeds the tolerance value, [any load] it is

assumed that a load element has [to] become [the short] shorted, and [after] steps including a step 6020 are carried out.

In [a] step 6020, [since] all of the loads which are then in [presented to] the "on" state [present to be the] are turned "off". [state, all] (All of the semiconductor switching elements of the output circuit are [presented to the] switched "off" [state].) In a step 6030, [a] the number m of the loads which have [presented at] been in the "on" state is [calculated] determined, and in a step 6040, the current IT is measured again.

Herein, when all of the semiconductor switching elements are [performed to the] switched "off", [state, in] then no current will flow, regardless of whether a [the] semiconductor switching element [becomes to the fail, then the current will not flow] has failed.

To judge this, in a step 6050, [it is compared that] a comparison is made to determine whether the current IT [to be] measured in step 6040 [again (the current during all] (all of the semiconductor switching elements [presenting to the] "off" [state]) exceeds the above stated tolerance value [or not]. When it does, [Herein, when the current IT is more than the above stated tolerance value,] the semiconductor switching element [become the fail] has failed, and also the load has experienced a [become the] dead short [fail] failure. The [reasons why]

reason is that when the load is normal (no failure) but the semiconductor switching element [becomes the fail] fails, there is no case where the current IT [is more than the above stated] exceeds tolerance value.

Accordingly, to [perform the shutdown] shut down the loop [system] power supply system so that no power is [not to] supplied [the power supply] to the [fail] failed point, firstly in a step 6150, [to perform the "off" state of] the load power supply shutdown circuit of the module which is connected to the power supply system which has [presented to the fail] failed is switched to the "off" state. [, in] In [a] step 6160, the [fail] failure information is sent to other [module] modules via a multiple bus.

In [the] a module which has received this [fail] failure information, when the information [is the information in which] indicates the load power supply shutdown circuit itself should be [performed to the] placed in an "off" state, immediately the load power supply shutdown circuit is [performed to the] switched "off" [state]. With the above stated construction, the failed power supply system can be [shutdown] shut down, and [then the continuation of the] a current [flowing] flow can be prevented.

Further, in a step 6170, the [fail] failure point and the [contents] nature of the [fail] failure are displayed, and

[further it stores] this information is stored as [the] service information [to] for the dealer. This stored information can be read out [according to] by the diagnosis apparatus shown in Fig. 1. etc.[.]

A manner for [performing the shutdown] shutting down the failed power supply system will be explained clearly, referring to the embodiment shown in Fig. 2.

As one example, it is assumed that both [of] a fuel pump 392 connected to RIM 29 [shown in] (Fig. 7) and a semiconductor switching element 364 for driving the fuel pump 392 [will be failed according to the] experience a dead short [fail] failure.

In this case, when the [fail] failure is detected (based on [in accordance with] the current which flows into the over-current detection circuit 361 of RIM 29), firstly a contact of the relay of the load power supply shutdown circuit 310 of the failed power supply system is [presented to the] switched "off" [state], and the electric power line 12E of the failed power supply system and the electric power line 12D of the normal power supply system are [carried out the shutdown operation] shut down.

Further, since the electric power line 12E of the failed power supply system is connected to the electric power line 12F, a contact of the relay of the second load power supply shutdown

circuit 210b of BCM 14 [shown in] (Fig. 6) in which the electric power line 12F is connected, is [performed to present to the] switched "off", [state,] and the electric power line 12F of the failed power supply system and the electric power line 12G of the normal power supply system are [performed to the shutdown] shut down.

Accordingly, since only the failed power supply system is [performed to the shutdown] shut down, the load which is connected to the normal power supply system can be operated normally.

When the current IT [which has] (measured again in the above stated step 6050) is less than the tolerance value, the semiconductor switching element [is] has not [the fail] failed, but [any] a component of the load is [presented to the] undergoing dead short. [In after] After the steps including a step 6060, it is [judged] determined that [any] a load component is [presented to the short] shorted.

In the step 6060, a numeric value n [for] (indicating a number of repetitions [what time repetition] of a following processing) is initialized to [be] the value "1". In a step 6070, after [only one] a single load which [has presented to] was in the "off" state is [presented to the] switched "on", [state, in a step 6070,] the current IT [during this time] is measured, and

[in a step 6090, the current IT in this time] is compared in a step 6090 with the above stated predetermined tolerance value. When it exceeds [When the current IT in this time is more than] the predetermined tolerance value, it [means] can be concluded that the load which [has presented to the] was switched "on" [state is performed to the] has experienced a dead short, and in a step 6110, [hereinafter] regardless the return condition is effected, the load is [performed to the] switched "off" [state]. Further, [in] at this time (similarly to the above)[,] in a step 6120[,] the [fail] failure information is displayed and stored.

[In a step 6090,] If the current value IT is less than the predetermined tolerance value in step 6090, then it is [judged] determined that the load is not [presented to the] dead [short,] shorted, and in [a] step 6100, the semiconductor switching element for driving the load is [presented to the] turned "on" [state, then it is performed as the normal operation] so that the load operates normally.

[With the] The above stated steps[,] complete the diagnosis [about] of one load [finished, but to]. To diagnose the remaining loads, in a step 6130, the [above stated numeric] numerical value n is [performed to increase] incremented by "1", and in a step 6140 it is [compared that] determined whether all processing [have] has been finished. [or not, and when the steps have] If not, [finished,] then the processing [after the] steps including

a step 6070 are repeated [and then when]. When all [the] steps have been finished, a step 6200 shown in Fig. 38 [which is a next processing] is carried out.

Fig. 38 shows a process for [performing the] switching "off" [state] the loads [according to the detection in which the] when a current [having more] greater than [a] normal [value] is detected [by the] due to a leak of the load, but not [according to the detection of the] a dead short.

In a step 6210, the current value IT is measured. In a step 6220, [the] a maximum current value ILMAX and [the] minimum current value ILmin for normal operation of all the loads [at the normal time] which are then operating [operate during the current value IT measurement] are searched, and further a number m of the operated loads is calculated.

For example, Fig. 39 shows an example of a center value of the normal operating current [at the normal time of] for the lamp from the start of the operation [starting], and Fig. 40 shows an example of a center value of the normal operating current [at the normal time of] for the motor from the start of operation [starting].

[As stated in above, the] Normal current data [of] for all of the loads [at the normal time have] are stored in advance in

a memory[, and the]. These data [is] are searched, and [the scattering data is added to the searched center value, in a following formula 1 and a following formula 2,] the maximum normal current value ILMAX and the minimum normal current value ILmin of all the loads [at the normal time] are calculated according to the following formulas 1 and 2.

$$\text{ILMAX} = \text{current at normal time} \times (1 + \alpha) \quad .. \quad \text{formula 1}$$

$$\text{ILmin} = \text{current at normal time} \times (I - \alpha) \quad .. \quad \text{formula 2}$$

Herein, α indicates a scattering degree.

In a step 6230, a [total] sum ITmax of the maximum current value and a [total] sum ITmin of the minimum current value of the normal current [value at the normal time] values of the loads which [have presented to] are in the "on" state are calculated according to [a] following [formula] Formulas 3 and [a following formula] 4.

$$\text{ITmax} = \sum_{n=1}^{m} \text{ILMAX} \quad . . . . . \quad \text{formula 3}$$

$$\text{ITmin} = \sum_{n=1}^{m} \text{ILmin} \quad . . . . . \quad \text{formula 4}$$

For example, when the two loads shown in Fig. 39 and Fig. 40 are operated, the total sum becomes the current value shown in Fig. 41.

Next, in a step 6240, the abnormality [judgement] judgment maximum and minimum current [value] values INGmax [is calculated according to a following formula 5 and the abnormality judgement minimum current value] and INGmin [is] are calculated according to [a] the following [formula] formulas 5 and 6.

INGmax = ITmax + A .... formula 5

INGmin = ITmin - A .... formula 6

Reference numeral "A" in the formula 5 and 6 is a predetermined constant value [having more] greater than zero (0).

In this embodiment, [the calculation about] the abnormality [judgement] judgment current value is calculated by adding [the] a predetermined constant value[,]; however in the alternative, it may be [requested according to the] calculated as a proportion [calculation].

The current value IT measured in a step 6210 and the abnormality [judgement] judgment current value calculated in [a] step 6240 are compared in a step 6250. When the current value IT

is larger than the abnormality [judgement] judgment minimum current value INGmin, and is less than the abnormality [judgement] judgment maximum current value INGmax, operation is judged to be [since it shows the] normal, and [the] processing is finished.

When, on the other hand, the current IT exceeds the normal range, [At the time except for the above case,] it is judged that [any] a load [becomes the abnormality and] has failed. In this case, to specify the abnormal load, [a] the following processing is carried out.

In a step 6260, a numeric value n (which indicates the number of times [the following] processing [are] has been repeated) [what times] is initialized to [be] a value of "1". In [a] step 6270, after 1 ms [where] one load which [has presented to the] was "on" [state] is [performed to the] switched "off", and [state,] in [a] step 6270, the current ITnew at this time is measured.

In a step 6290, when the [varied] variation of the current value (IT -ITnew) [according to] in the "off" state is smaller than the maximum current value ILMAX of the load which was requested by the search in the step 6220 and is larger than the maximum current value ILmin, the load is normal[, and then]. Then, in a step 6300, the semiconductor switching element for

driving the load is [performed to the] turned "on", for normal [state, and it made to be the] operation [at the normal time].

In [a] step 6290, if it is [judged] determined as [the] a load abnormality, regardless the return condition is effected, the load switched [is performed] to the "off" state. Further, in a step 6320, the [fail] failure information is displayed and stored.

To diagnose the remaining loads, in a step 6330, the above stated numeric value n is [performed to increase] increased by "1", and in a step 6340 it is [compared that] determined whether all processing [have] has been finished [or not, and when the steps have]. If not [finished], [the processing after] the previous steps including a step 6270 are repeated.

[As stated in] According to the above, when both [of] the load and the semiconductor switching element [become the] short circuited [fail], since the power supply system is [performed to the shutdown] shut down, the loop [system] power supply system is not [received any affect] affected.

Further, when the short and the rare short of the load is detected, it is possible to shut down only the corresponding semiconductor switching element [can be performed to the shutdown], so that only the [fail] failure point is separated,

and [then any] other loads [is] are not [received the affect] affected.

Further, in this embodiment, [to] as noted above, the semiconductor switching [element the matter having the] has an over-temperature detection shutdown function. [in the interior portion is employed, as stated in above, since] Since the current of the respective individual loads is detected, the protection function of the semiconductor switching element [can be performed to] may have [the over-current limitation function having] a large scattering range, the only [to aim not to destroy] goal being to avoid destroying the semiconductor switching element; and the short protection can be carried out fully[, accordingly]. Accordingly, the construction of the semiconductor switching element can be simplified.

Fig. 23 shows another embodiment of the over-current detection circuit, [and the different points in] which differs from the construction shown in Fig. 22 [is] in that a fuse is connected to a shunt resistor 2020 in series.

In this circuit, the [fail] failure detection and the fail safe processing shown in Fig. 37 and Fig. 38 are carried out[, and further when the failed power system is not performed the shutdown even]. Further whether or not the failed power system is [performed the shutdown, since] shut down, because of the fuse

2030 [is fused], the [fail] failure point can be [performed the shutdown] shut down.

Fig. 24 shows a further another embodiment of the over-current detection circuit, [and the different points shown in] which differs from Fig. 22 [is] in that a protection element (hereinafter, PTC element) 2220 having a PTC characteristic ([the characteristic] when the temperature [is risen] rises, the resistance [is increased] increases) is used in place of the shunt resistor 2010.

PTC element has the temperature characteristic [as] shown in Fig. 25(a) and when [the] its temperature [of the element is risen more than some temperature] rises above a preset value (in this embodiment about 120°C), [the] its resistance value increases abruptly[. The resistance value having about], from several [ten] tens of mΩ [of PTC element in this embodiment increases the temperature having from about several ten kΩ] to about several hundred kΩ.

Further, the factor [in] which causes the temperature [raises] to rise is the current which flows into the PTC [PCT] element[, and a]. The relationship between the current and [a] time (a trip time) for abruptly increasing [abruptly] the resistance value is shown in Fig. 25(b). The characteristics 2310, 2320 and 2340 are the characteristics when the respective

surrounding temperatures are 0°C, 20°C and 60°C, respectively[, at the time of the]. When the current [having] is more than 15A, [the characteristic is that] the resistance value increases in less than one second.

With this [PCT] PTC element the current is detected[, when the]. When a very large current flows, since the resistance value of PTC element is increased, and [since] because of the potential difference between PTC elements, [it appears the] a large difference occurs [in] between the detection [voltage at] voltages in the normal [time] and [at the] abnormal [time] conditions. Accordingly, the detection accuracy is made rough.

Further, in this circuit, the [fail] failure detection and fail safe processing are shown in Fig. 37 and Fig. 38. However, [but] when an attempt is made to shut down the failed power supply system [is tried to perform the shutdown] but the shutdown processing is not carried out, since the resistance value of PTC element is increased, the current value can be restrained, and therefore the flow continuation of the over-current can be prevented.

In the embodiments shown in Fig. 2, Fig. 3 and Fig. 4, in which the power bus 12 [which] makes a [round] circuit in the vehicle [is installed], when the electric power line becomes [the] short [circuit] circuited [in the vehicle], the power

supply is [not supplied] <u>cut off</u> to all of modules<u>,</u> [and then] <u>so that</u> almost all functions of the automobile are made to stop.

Accordingly, in the embodiment examples, when there is [an afraid] <u>a danger</u> of the short circuit in the electric power line, such a short circuit is detected before [this] <u>it</u> happens<u>,</u> and the necessary treatments can be carried out.

One construction [elements] <u>element</u> of the above stated treatments is the electric power line having the above stated short sensor. As the embodiment of the electric power line, three kinds of the constructions shown in Fig. 26, Fig. 27 and Fig. 28 are shown.

In the construction shown in Fig. 26, <u>a connector 3050 is employed</u> to connect to the module[, a connector 3050 is employed]. A rubber plug 3080 has a role of [the] water [proof] <u>proofing</u>. The electric power line 3020 is connected to a terminal <u>coupler</u> 3060 [with] <u>in the manner of</u> a faucet<u>,</u> [manner] and [is] <u>the latter is fitted and</u> connected to the connector of the module [with the fitting].

Similarly [to], a short sensor 3010 [made by] <u>in the form of</u> a connector for shield is connected to a terminal 3070 [with] <u>in the manner of</u> a faucet [manner] and is <u>fitted and</u> connected to the connector of the module [with the fitting-into].

In the construction shown in Fig. 27, the short sensor constituted by the connector for the shield [is constituted by] comprises an aluminum film 3010a and a drain wire 3010b which contacts to an inner side of the aluminum film. With [the] this construction, when the terminal 3070 is carried out by performing the faucet manner, since it is unnecessary to untie the connector for shied, the process manner can be carried out easily.

Further, in comparison with the connector for shield, since the conductive body can be formed at all faces, even in the case of a [the] contact with the material such as a needle, the short can be detected[, accordingly]. Accordingly, the detection performance [as] of the short sensor can be improved.

[The] In the construction shown in Fig. 28, [is a construction in which] the drain wire 3010b shown in Fig. 27 is deleted.

In this case, a connector 3050a is provided to connect the short sensor 3010a to the module[, it is necessary to devise a connector 3050a]. The electric power line is connected to the terminal 3060 in the manner of a [with the] faucet [manner] as shown in Fig. 26 and Fig. 27; but a connector 3070a for connecting the short sensor to the module is formed with the connector as one body as shown in figure.

The connector 3070a is buried with a cylindrical form at an inner periphery of a harness side of the connector 3050a and is formed with a portion for connecting the module as one body and further has the same potential.

On the other hand, the short sensor 3010 of the electric power line is connected to a faucet portion of another relay terminal 3080 <u>in the manner of</u> [with] a faucet [manner].

In the relay terminal 3080, a faucet portion of the short sensor, a portion having a spring force to connect according to a contact with the terminal 3070a and a portion for connecting the two portions are formed as one body.

The procedure [of the process] <u>for assembly of this apparatus</u> is that firstly the terminal 3060 and the electric power line 3020 are connected [to with the] <u>in the manner of a</u> faucet [manner], the short sensor 3010a and the relay terminal 3080 are connected [to with the faucet] <u>in a similar</u> manner, and the faucet member is inserted to the connector 3050a. In the short sensor, between the relay terminal 3080 and the terminal 3070a is connected with the connection manner.

With this construction, the structure of the electric power line can be simplified, and further the terminal process of the short sensor can be simplified.

Next, [a] the manner [for] of detecting [the] a short using the short sensor will be explained. [As to the] The short detection circuit which is provided in the respective modules will be explained referring to Fig. 5, by [exemplifying] means of the representative example of one circuit part of the short detection circuit 130 of FIM 5 shown in Fig. 5.

[The explanation of the construction shown in Fig. 5 will be omitted because the statements have stated in above.]

When a control signal of a voltage application drive circuit 131 is controlled [with] by a pulse [shape] shaped waveform as [shown in the] a drive signal, as shown in Fig. 29, [in the] during normal operation a drive signal [time the waveform] having the same [drive signal] waveform is inputted in a control circuit 170[, when]. When, however, it is [performed the short] shorted to [the] ground (hereinafter a lower side short), that portion of the waveform which is originally [to be] at a high potential becomes a low potential.

Further, when [the] a short [is performed to] occurs in the electric power line (hereinafter, an upper side short), that portion of the waveform which is originally [to be] at a low potential becomes a high potential.

[According to the] Using detection [of this] logic, it can be detected that whether the short sensor is the lower side short or is the upper side short.

Further, as explained in Fig. 2, since the short sensor has an open condition at portions of the connectors 17A, 17B, 17C and 17D, it can detect [that] in FIM 5[, the] a lower side short and the upper side short of the electric power lines 12A and 12H[,]; in BCM 14[,] it can detect a [the] lower side short and [the] an upper side short of the electric power lines 12B, 12C, 12F and 12G[,]; and in RIM 29[, the] it can detect a lower side short and [the] an upper side short of the electric power lines 12D and 12E. In this way, [and then] the [fail] failure point can be specified.

Further, according to the [connector] manner of connection, since the electric power lines 12B, 12C, 12F and 12G are separated in the cabin, and the electric power lines 12D and 12E are separated in the trunk [room] compartment, in [a case of a mending of] order to correct the [fail point] failure, it [can be constituted] is necessary to mend only one harness.

In [this] the embodiment [stated in] described above, when there occurs [an afraid about the] a danger of a short circuit in the electric power line, the [afraid] danger is detected before the short occurs, [it happens] and the necessary

treatments are carried out[, the functions]. The function and [the operations] operation of the load power supply shutdown circuit, which is [the] an important [construction of the function] component will be explained.

[The functions of the load power supply shutdown circuit, as] As explained in [the above stated construction shown in] Fig. 37, there are the following functions: [which are the function for] separating the [fail] failure point from the power bus 12 during [the] a dead short of the load and during [the] a dead short of the output circuit[, the]; a fail safe function for separating the [fail] failure point from the power bus 12 by detecting beforehand [the] an upper [side short and the] or lower side short of the electric power line [which will be] (explained [in a latter portion] later); [,] and [the] a sleep function for reducing the current consumption [current] by [carrying out the shutdown] shutting down the power supply [supplying] when [the man does not exist in the vehicle and] the vehicle is left [alone] unoccupied.

Using the construction shown in Fig. 36, [in a whole system, it will be explained that how the above stated] the fail safe function and the [above stated] sleep function [are carried out] will be explained.

In a step 5000, it is [judged that] determined whether [it is the sleep condition where the man does not exist in the vehicle and] the vehicle is in a "sleep condition" (the vehicle is left alone and unoccupied) or [whether the] in a normal operation condition[, for]. For example, when the ignition switch is [presented to the] "on", [state and] the accessory switch is [presented to the] "off" state, [and the] all of the doors are [the closing conditions] closed, and there is no load being operated, it is judged as the sleep condition.

When it is judged as the sleep condition, in a step 5060, the load power supply shutdown circuit is [performed the shutdown] shut down, and the power supply [supplying] to the loads is [performed the shutdown] shut down. For this purpose, [As a device for carrying out the shutdown the load power supply shutdown circuit] a relay is employed, [and this relay is that the connection is carried out when] in which the current [is continued] continues to flow to the load when the connection is made. When the connection is made during the sleep condition [that the connection is carried out] the current [is continued] continues to flow to the coil, the battery is discharged.

As stated [in] above, during the sleep condition when the load power supply [shutdown] is shut down, [circuit is performed the shutdown,] the current does not flow into the coil of the relay and the leakage current of the semiconductor switching

element which is employed in the output circuit does not flow[, accordingly]. Accordingly, the consumption of the current can be restrained.

Further, since the power supply for the coil of the relay and the control system power supply are [formed with the] coupled to the power bus 12 by separate power supplies [against the power bus 12], even when the load power supply shutdown circuit is [performed the shutdown] shut down, the control circuit can be operated.

During [the] normal operation [condition], in a step 5010, [in all of the modules which are connected to the power bus 12,] the diagnosis for the power bus is carried out in all of the modules which are connected to the power bus 12.

[As the] For diagnosis [manner], the short detection [manner according to] process by the short sensor stated [in] above is carried out. [As the] For diagnosis [for] of the power bus, the aim will be attained using [the] current detection [manner].

[As the result of the diagnosis, when it] When a failure is [judged as the fail] determined to exist in a step 5020, in a step 5030, the [fail] failure information (such as the [fail] failure point and the nature of the failure [fail contents] etc.) is displayed, and [it] is stored in the memory[, in a]. In step

5040, the connection of the shutdown of the load power supply shutdown circuit of the respective modules is carried out, according to [as shown in] the logical value table shown in Fig. 31, based on [in response to] the [fail] failure point.

In [a] the case [of the] when all components operate normally [normality], according to the logic [during the normality of the logic] value table shown in Fig. 31, the connection and the shutdown of the load power supply shutdown circuit can be carried out.

As [an example of the] a representative example [for showing] to show the logic of the load power supply shutdown circuit shown in Fig. 31, in which the [fail] failure point is [performed the shutdown] shut down, a case will be explained in which [wherein] the electric power line 12 is [the short will be explained] shorted.

With respect to [The construction of the embodiment of] the overall system, the operation will be explained referring to construction shown in Fig. 2[,]; and with respect to the modules FIM 5, BCM 14 and RIM 29, the explanation will be made referring to Figures 5, 6 and 7, respectively. [the construction of the embodiment of the module will be explained referring to FIM shown in Fig. 5, the construction of the embodiment of the module will be explained referring to BCM 14 shown in Fig. 6, and the

construction of the embodiment of the module will be explained referring to RIM 29 shown in Fig. 7, respectively.]

[When in FIM 5 the] In FIM 5, a short of the electric power line 12A shown in Fig. 2 is detected in advance, a contact of the relay of the first load power supply shutdown circuit 110a of FIM 5 and a contact of the relay of the first load power supply shutdown circuit 210a of BCM 14 are [performed the shutdown,] shut down; and the relay of the load power supply shutdown circuit 310 of RIM 29 (which [has performed the shutdown] is shut down during [the] normal [time] operation) is connected.

The failed point electric power line 12A and the electric power line 12B, which [is] are connected [directly] together by the connector 17A, are [performed] completely [the shutdown according to] shut down in the power bus 12.

When the contact of the relay of the first load power supply shutdown circuit 210a of BCM 14 is [performed the shutdown] shut down, the electric power line 12C is [performed the shutdown] shut down according to the power bus 12[, however]. However, since the relay of the load power supply shutdown circuit 310 of RIM 29, which [has performed the shutdown] is shut down during [the] normal [time] operation, is connected, [the] power [supply] is supplied from the reverse direction [against] compared to the normal [time] operation.

Accordingly, only a part of the failed electric power line is [performed the shutdown,] shut down; and only the loads (in this embodiment, [only] the head lamp left 1, the turn lamp left, the horn 8, PDM 20), which [are received the supply of the] receive their power supply from the electric power line, [can not] cannot be operated. The other loads, being supplied with power from the reverse direction can be operated.

[The construction of the embodiment of the system will be explained referring to construction shown in Fig. 2, the construction of the embodiment of the module will be explained referring to FIM shown in Fig. 51 the construction of the embodiment of the module will be explained referring to BCM 14 shown in Fig. 6, and the construction of the embodiment of the module will be explained referring to RIM 29 shown in Fig. 7r respectively.

When in FIM 5 the short of the electric power line 12A shown in Fig. 2 is detected in advance, the contact of the relay of the first load power supply shutdown circuit 110a of FIM 5 and the contact of the relay of the first load power supply shutdown circuit 210a of BCM 14 are performed the shutdown, and the relay of the load power supply shutdown circuit 310 of RIM 29 which has performed the shutdown during the normal time is connected.

The failed point electric power line 12A and the electric power line 12B which is connected directly by the connector 17A are performed completely the shutdown according to the power bus 12.

When the contact of the relay of the first load power supply shutdown circuit 210a of BCM 14 is shutdown, the electric power line 12C is performed the shutdown according to the power bus 12, however since the relay of the load power supply shutdown circuit 310 of RIM 29 which has performed the shutdown during the normal time is connected, the power supply is supplied from the reversal direction against the normal time.

Accordingly, only a part of the failed electric power line is shutdown, the power supply supplying to the loads is supplied from the reversal direction, the apparatus can be operated.]

[The construction shown in] Fig. 32 [is] shows another manner of fail safe operation of the load power supply shutdown circuit. [during the fail safe time, in] In the [construction] table shown in Fig. 31, during [the] normal [time] operation, the load power supply shutdown circuit 310 of RIM 29 is [presented to the] turned "off"; [state,] however Fig. 32 [this] differs [a case where] in that all of the load power supply shutdown circuits are [presented to the] "on" [states] during normal operation.

When the load power supply shutdown circuit 310 of RIM 29 is [presented to the] "off" [state] during [the] normal [time] operation, at the time [of the] when a short is [detection manner according to the] detected by current detection, since the direction of the current is fixed, the detection can be carried out easily.

Further, when the load power supply shutdown circuit 310 of RIM 29 is [presented to the] "on" [state] during [the] normal [time, a time for performing the "on" state] operation, the time required to turn the load power supply shutdown circuit 310 of RIM 29 on during the normal [time] operation can be shortened.

Fig. 33, Fig. 34 and Fig. 35 are respectively the process flow charts of BCM 14, FIM 5 and RIM 29 when the logic shown in Fig. 31 is controlled.

Further, Fig. 36 is a process flow chart of RIM 29 when the logic shown in Fig. 32 is controlled. [The] Since the constructions are substantially the same, [ones, it will be explained] the flow chart of BCM 14 shown in Fig. 33 will be explained as [the] a representative example.

In a step 5100, if it is judged [as] that the vehicle is in a sleep condition, in a step 5200, the first load power supply shutdown circuit 210a and the second load power supply shutdown

circuit 210b are [performed the shutdown] shut down, and [then] the process [has] is finished.

On the other hand, in [In] the ordinary operation condition (not sleep), in [a] step 5110, the diagnosis of the power bus is carried out according to the short detection circuit 230[, as a result, in]. In a step 5120 when [it is judged as the fail] a failure is detected, in a step 5130, the diagnosis information in which any [fail] failure point exists in another module is received by the multiple communication bus, and then [after] the steps including a step 5160 are carried out.

On the other hand, in [a] the case of [the normality, since it is judged] operation, to judge whether or not there exists [the fail] a failure on the electric power line [which diagnoses the fail] in another module, [or not,] in a step 5140, the diagnosis information from the other modules are received. When it is determined, based on this information that a failure has occurred, [In accordance with the above stated diagnosis information, in a step 5150 when it is judged as the fail,] in a step 5160, [where fail] the failure point is [judged, and when] determined. When the fail point is any of the electric power lines 12E, 12F, 12G and 12H, in a step 5180, the second load power supply shutdown circuit 210b is [performed the shutdown,] shut down, and in a step 5210, the [fail] failure point is displayed, and [it] this information is stored in the memory.

In a step 5150, when there is no [fail point] failure, the first load power supply shutdown circuit 210a and the second load power supply shutdown circuit 210b are connected and then the process has finished.

Since the process flow charts in other modules are the same ones, [it] a further detailed explanation of them will be omitted. With the above processes, [in above,] a system operation shown in Fig. 30 can be carried out.

Fig. 42 and Fig. 43 [are the construction views for showing] show the connection [manner] manner of the module with the power bus 12.

The construction is constituted by a module [4000] 7000 shown in Fig. 42, power buses 7020, 7030, 7040 and 7050 and an electric power line 7020a, a short sensor 7020b. Only the power buses are connected to the module [700 according to] 7000 by a connector 7010[,]; another electric power line 7060 is connected to the module 7000 with another connector 7080. In the construction shown in Fig. 43, the power buses 7020, 7030, 7040 and 7050 and the another electric power line 7060 are connected to a module 7100 with the same connector 7110.

As shown in the construction shown in Fig. 42, when it is connected to the module using the connector having the power bus, according to a number of the other electric power lines, since it is unnecessary to alter the connector, [the standardization of the connector] which can be standardized. [attained.]

Further, as shown in [the construction shown in] Fig. 43, when the integral connector is employed, the occupation area of the connector can be deleted, accordingly the module can be made small.

Fig. 44 is [the construction] a view [in] which shows the shunt resistor used in the over-current detection circuit [is] installed in the connector of the module.

[The construction is constituted by a] A connector housing 8040 of the module [is] includes the connector terminals 8000 and 8010, and a shunt resistor 8030[, and the]. The connector housing 8040 and the shunt resistor 8030 are [connected] welded or soldered to the connector terminals 8000 and 8010. [according to the welding manner or the soldering manner.]

The construction is constituted by an electric power line 7020a of the power bus[,] and a short sensor 7020b[, and the]. The electric power line 7020a and the short sensor 7020b are

connected respectively to module side terminals 8010 and 8050 through terminals 8070 and 8080.

In the construction shown in Fig. 45 compared with the construction shown in Fig. 44, the shunt resistor 8030a and the connection terminal 8000 are formed as one body 8030b.

As stated [in] above, since the shunt resistor is installed in the interior portion, the distance for flowing the large current can be shortened[, further also]. Also, the size of the module can be made small.

According to the present invention, [there are effects that] the number of fuses [fuse number] can be made [small, further] decreased, the wire harness for supplying [the] power [supply] can be shortened [or can be lessened].

According to [another] invention, not only the occurrence of [the] short circuit [abnormality] of the electric power line can be prevented in advance, but [and] also the [abnormality] failure point during the short circuit [abnormality occurrence] can be specified.

Further, according to a further feature of the invention, since [the] an over-current detection circuit is provided, when

the load [being the fail such a] <u>fails, the</u> failed [load] <u>portion</u> can be separated.

Further, according to [a furthermore] <u>another feature of the</u> invention, the consumption <u>of</u> current of the power supplying apparatus during the non-operation of the vehicle can be reduced.

<u>The foregoing disclosure has been set forth merely to illustrate the invention and is not intended to be limiting. Since modifications of the disclosed embodiments incorporating the spirit and substance of the invention may occur to persons skilled in the art, the invention should be construed to include everything within the scope of the appended claims and equivalents thereof.</u>